

AD-A106 087

NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/G 13/13  
NATIONAL DAM SAFETY PROGRAM, CROGHAN DAM (NORTH & SOUTH) (INVEN--ETC(U)  
APR 81 @ KOCH; W M SMITH DACW51-79-C-0001

UNCLASSIFIED

24

lot 2  
#106 097

ADAI06087

AD A106087

# BLACK RIVER BASIN

## CROGHAN DAM (NORTH & SOUTH)

LEWIS COUNTY, NEW YORK  
INVENTORY NO. N.Y. 694

### PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

⑩ George / K. L.  
W. T. / Smith



N. Y.

⑥ National Dam Safety Program.  
Croghan Dam (North & South)  
(Inventory Number 694), Black River  
Basin, Lewis County, New York.  
Phase I Inspection Report.

DTC FILE COPY

⑪ 23 apr 81

10 113

APPROVED FOR PUBLIC RELEASE;  
DISTRIBUTION UNLIMITED

⑮ DACN 51-74-2-KC-1

THIS DOCUMENT IS NOT QUALITY ASSURED  
THE COPY IS UNCLASSIFIED  
SIGNIFYING THAT IT SHOULD NOT BE  
REPRODUCED OR USED

NEW YORK DISTRICT CORPS OF ENGINEERS

MARCH, 1981

45

393 770 81 10 20  
L

## REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS  
BEFORE COMPLETING FORM

1. REPORT NUMBER

2. GOV ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)

Phase I Inspection Report  
Croghan Dam South  
Black River Basin, Lewis County, N.Y.  
Inventory No. 694

5. TYPE OF REPORT & PERIOD COVERED  
Phase I Inspection Report  
National Dam Safety Program

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)

GEORGE KOCH

8. CONTRACT OR GRANT NUMBER(s)

DACW51-79-C-0001

9. PERFORMING ORGANIZATION NAME AND ADDRESS

New York State Department of Environmental  
Conservation 50 Wolf Road  
Albany, New York 12233

10. PROGRAM ELEMENT, PROJECT, TASK  
AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS

Department of the Army  
26 Federal Plaza New York District, CofE  
New York, New York 10287

12. REPORT DATE

23 April 1981

13. NUMBER OF PAGES

14. MONITORING AGENCY NAME &amp; ADDRESS (if different from Controlling Office)

Department of the Army  
26 Federal Plaza New York District, CofE  
New York, NY 10287

15. SECURITY CLASS. (of this report)

UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING  
SCHEDULE

15. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; Distribution unlimited.

"Original contains color  
plates: All DTIC reproductions  
will be in black and  
white"

THIS DOCUMENT IS BEST QUALITY PRACTICABLE.  
NEW COPY FURNISHED TO DDC CONTAINED A  
SIGNIFICANT NUMBER OF PAGES WHICH DO NOT  
REPRODUCE PROPERLY.

16. SUBJECT TERMS (Continue on reverse side if necessary and identify by block number)  
Dam Safety  
National Dam Safety Program  
Visual Inspection  
Hydrology, Structural Stability

Croghan Dam South  
Lewis County  
Black River Basin

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

A visual inspection of this dam and the engineering analyses performed revealed that there are a number of structural deficiencies on this structure.

DD FORM 1 JAN 73 1573 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

AD A106087

DTIC FILE COPY

DTIC  
SELECTED  
OCT 26 1981  
H

X6

## **DISCLAIMER NOTICE**

**THIS DOCUMENT IS BEST QUALITY  
PRACTICABLE. THE COPY FURNISHED  
TO DTIC CONTAINED A SIGNIFICANT  
NUMBER OF PAGES WHICH DO NOT  
REPRODUCE LEGIBLY.**

## PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE 1 INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
CROGHAN DAM (NORTH AND SOUTH)  
I.D. NO. NY 694  
# 112A-340 BLACK RIVER BASIN  
LEWIS COUNTY, NEW YORK

TABLE OF CONTENTS

	<u>PAGE NO.</u>
- ASSESSMENT	-
- OVERVIEW PHOTOGRAPH	-
1 PROJECT INFORMATION	1
1.1 GENERAL	1
1.2 DESCRIPTION OF PROJECT	1
1.3 PERTINENT DATA	2
2 ENGINEERING DATA	4
2.1 GEOTECHNICAL DATA	4
2.2 DESIGN RECORDS	4
2.3 CONSTRUCTION RECORDS	4
2.4 OPERATION RECORDS	4
2.5 EVALUATION OF DATA	4
3 VISUAL INSPECTION	5
3.1 FINDINGS	5
3.2 EVALUATION OF OBSERVATIONS	6
4 OPERATION AND MAINTENANCE PROCEDURE	7
4.1 PROCEDURES	7
4.2 MAINTENANCE OF THE DAM	7
4.3 WARNING SYSTEM	7
4.4 EVALUATION	7

Distribution for	
NTIS GRIST	<input checked="" type="checkbox"/>
ERIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
Date	
Distribution/	
Availability Codes	
Initial and for	
Dist Special	
A	23

	<u>PAGE NO.</u>
5 HYDROLOGIC/HYDRAULIC	8
5.1 DRAINAGE AREA CHARACTERISTICS	8
5.2 ANALYSIS CRITERIA	8
5.3 SPILLWAY CAPACITY	8
5.4 RESERVOIR CAPACITY	9
5.5 FLOODS OF RECORD	9
5.6 OVERTOPPING POTENTIAL	9
5.7 EVALUATION	9
6 STRUCTURAL STABILITY	10
6.1 EVALUATION OF STRUCTURAL STABILITY	10
7. ASSESSMENT/RECOMMENDATIONS	12
7.1 ASSESSMENT	12
7.2 RECOMMENDED MEASURES	12

#### APPENDIX

- A. PHOTOGRAPHS
- B. VISUAL INSPECTION CHECKLIST
- C. HYDROLOGIC/HYDRAULIC ENGINEERING DATA AND COMPUTATIONS
- D. STRUCTURAL STABILITY
- E. REFERENCES
- F. DRAWINGS

PHASE 1 REPORT  
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Croghan Dam (North and South) (I.D. No. NY 694)
State Located:	New York
County:	Lewis
Watershed:	Black River Basin
Stream:	Beaver River
Date of Inspection:	October 15, 1980

ASSESSMENT

A visual inspection of this dam and the engineering analyses performed revealed that there are a number of structural deficiencies on this structure.

The structural stability analyses indicate that the factors of safety against both overturning and sliding are less than desirable. When the dam is subjected to severe loading conditions (ice load, flood flows), the safety factors fall to critical levels. Further investigation of the stability is needed including subsurface investigations and concrete coring. This information should then be incorporated into a detailed stability evaluation. Appropriate modifications to the dam should then be made.

It is recommended that within 6 months of the date of notification of the owner these investigations should be commenced, within 18 months, necessary modifications to improve the stability of the structure should be completed.

The hydrologic/hydraulic analysis performed indicates that the spillway does not have sufficient capacity to discharge the peak outflow from one-half the Probable Maximum Flood (PMF). However, a high tailwater condition could be expected for this storm event and a dam failure would not significantly increase the hazard to loss of life from that which would exist just before an overtopping induced failure. Therefore, the spillway capacity for this structure has been rated as inadequate.

A number of other deficiencies were noted on this structure. These deficiencies should be corrected within 18 months of the date of notification of the owner. Among the required actions are the following:

1. Repair tilting pier at right end of log sluice;
2. Replace missing concrete on walls supporting intake structures;
3. Repair deteriorated concrete on all spillways;
4. Repair scoured concrete at base of pier on right end of log sluice;
5. Repaired spalled concrete on the retaining wall adjacent stoplog structure # 1;

6. Investigate seepage through the left abutment wall adjacent stoplog structure #2;
7. Remove brush and trees growing on both sides of wall connecting the two spillways;
8. Repair the leaking low-level outlet at the spillway #3;
9. Develop an emergency action plan for notification of downstream residents.

*George Koch*

---

George Koch  
Chief, Dam Safety Section  
New York State Department  
of Environmental Conservation  
NY License No. 45937

Approved By:

*W.M. Smith Jr.*

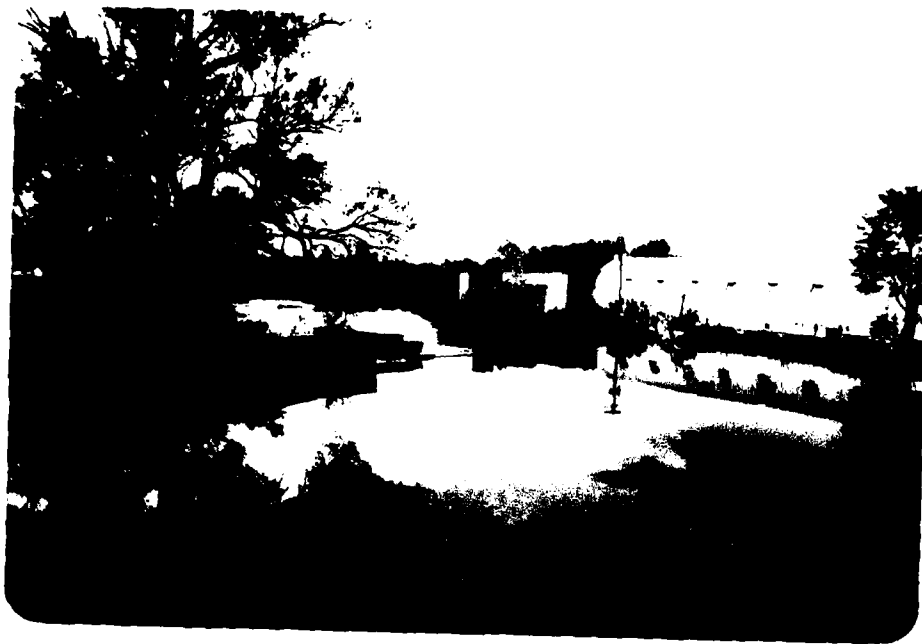
---

Col. W.M. Smith Jr.  
New York District Engineer

Date:

---

27 APR 1981



OVERVIEW PHOTO  
CROGHAN DAM (NORTH)  
I.D. No. NY 694



OVERVIEW PHOTO  
CROGHAN DAM (SOUTH)  
I.D. No. NY 694

PHASE 1 INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
CROGHAN DAM (NORTH AND SOUTH)  
I.D. NO. NY 694  
# 112A-340 BLACK RIVER BASIN  
LEWIS COUNTY, NEW YORK

SECTION 1: PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Phase I inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers, to fulfill the requirements of the National Dam Inspection Act, Public Law 92-367.

b. Purpose of Inspection

This inspection was conducted to evaluate the existing conditions of the dam, to identify deficiencies and hazardous conditions, to determine if these deficiencies constitute hazards to life and property, and to recommend remedial measures where required.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam

The Croghan Dam is a run-of-river concrete gravity dam on the Beaver River. An island divides the river into two segments in the vicinity of the dam. There are two main segments of the dam, one crossing each portion of the river. A retaining wall extends across the island connecting the two segments.

The north segment of the dam is 180 feet long and 11.5 feet high. This segment of the dam is predominantly an overflow spillway section. There are intake structures on both ends of the segment and a log sluice near the center. The intake structures originally led to flumes providing water power to downstream mills. The flumes no longer exist and the structures now act as spillway sections. Stop logs have been placed in each up to a level slightly below the spillway crest. The log sluice is also no longer used and stop logs have been placed across the upstream end.

The south segment of the dam is 120 feet long and 9.5 feet high. The spillway forms the entire center section of this segment. There is an intake structure for a flume leading to the one remaining water powered mill at this site. A trash rack extends across the entrance to this structure. At the left end of this segment are the remains of an intake structure for a saw mill flume. Stop logs have also been placed across this intake structure. There is a 4.5 foot wide by 5 foot high opening at the base of the spillway near the center of this section that serves as a low level outlet. Stop logs closed off this outlet.

The retaining wall which connects the two segments is a total of 240 feet long and a maximum of 11 feet high. The base of the wall is masonry and the upper portion is concrete. The area downstream of the wall has been backfilled up to about one foot below the top of the wall along much of its length.

b. Location

This dam is located on the Beaver River in the Village of Croghan. It is adjacent Resha Road which is just off County Route 10.

c. Size Classification

The dam is 11.5 feet high and has a storage capacity of approximately 500 acre feet. Therefore, the dam is in the small size category as defined by the "Recommended Guidelines for Safety Inspection of Dams".

d. Hazard Classification

The dam is classified as "high" hazard due to 3 homes plus a lumber yard on the island immediately downstream of the dam.

e. Ownership

There are multiple owners of this dam. A listing of Hudson River-Black River Regulating District assessments dated June 30, 1980 indicated the owners of the parcels of land which include the dam are as follows:

<u>Parcel Number</u>	<u>Portion of Dam in Parcel</u>	<u>Owner</u>
38	Left end of southern dam	Vaughn Zehr
39	Right end of southern dam up to bridge on island	Croghan Island Mill Lumber Co.
40 & 41	Remainder of dam from bridge on island to right end of northern dam	Beaverite Products Corp.

f. Purpose of Dam

The dam was constructed to provide water power to four mills at this site. Only the Croghan Island Mill Lumber Company still uses the water for power. Beaverite Products Corp uses the impoundment as a water supply for their fire-fighting sprinkler system.

g. Design and Construction History

This dam was constructed in 1918 to replace a former log crib structure. The dam was designed by James P. Brownell, Civil Engineer, of Carthage, New York. The contract for construction was awarded to Mr. H. J. Wright of Watertown, New York.

h. Normal Operation

There are no prescribed operating procedures for this structure.

1.3 PERTINENT DATA

<u>a. Drainage Area (sq. mi.)</u>	293	
<u>b. Discharge at Dam (cfs)</u>		
Spillways Water Surface at Elevation	105	4308
Normal Flow-Water Surface at Elevation	100	300

c. Elevation (Plan Datum)

Top of Dam	105
Spillway Crest	100
Base of Log Sluice	90.5

d. Reservoir Storage Capacity (acre feet)

Top of Dam	797
Spillway Crest	482

e. Dam

Type-Concrete dam with 2 main sections and a retaining wall connecting the two segments.

Dam Length (ft)	500
-----------------	-----

f. Spillway

Type: Two concrete gravity spillway sections; northern section 80 feet long, southern section 100 feet long.

Four flume intake structures and a log sluice also act as spillway. All have stop logs across openings up to elevation slightly below spillway crest. Total length of these sections is about 70 feet.

g. Reservoir Drain

Type-Low-level outlet at downstream toe of southern spillway section, 4.5 foot wide by 5 foot high; plugged by stop logs.  
Control-Stop logs plug the opening.

h. Appurtenant Structures

Croghan Island Mill-water powered saw mill adjacent stop log structure # 3. Intake structure at spillway with trash rack for debris protection. Flume leading to mill constructed of timber.

## SECTION 2: ENGINEERING DATA

### 2.1 GEOTECHNICAL DATA

#### a. Géology

The Croghan Dam is located in the Western Adirondack Hills section of the Adirondack Highlands physiographic province of New York State. The Beaver River, on which this dam is located, is one of a number of streams which flow down from the higher parts of the mountains into the Black River. The bedrock in these highlands is sedimentary with large intrusions of igneous rocks. The original rock has been metamorphosed by heat, pressure, folding and faulting. The design report indicates that the rock in the vicinity of the dam is gneiss which is unstratified although it does show a faint line of cleavage in a plane running approximately north and south. Occasional seams of mica-schist are found within the rock mass. A review of the "Brittle Structures Map of the State of New York" indicated that there are no faults in the immediate vicinity of the dam.

Surficial soils in the area consist of a relatively thin layer of glacial drift from the Wisconsin glaciation.

#### b. Subsurface Investigations

No records of any subsurface investigations performed in the vicinity of this structure could be located.

### 2.2 DESIGN RECORDS

An engineer's report and a set of plans prepared in May, 1918 by James P. Brownell, Civil Engineer of Carthage, New York was available. This report contained hydrologic, hydraulic and structural stability information used in the design of this dam.

### 2.3 CONSTRUCTION RECORDS

The engineer's report stated that the dam was to be constructed by Mr. H.J. Wright of Watertown, New York. Some other construction records such as a report on the testing of materials to be used in the concrete on the dam were also available.

### 2.4 OPERATION RECORDS

No operation records were available for this structure.

### 2.5 EVALUATION OF DATA

Information used for the preparation of this report was obtained from the Department of Environmental Conservation files. The information available appeared to be reasonably accurate although there were certain details which were not shown on the plans.

## SECTION 3: VISUAL INSPECTION

### 3.1 FINDINGS

#### a. General

Visual inspection of the Croghan Dam was conducted on October 15, 1980. The weather was partly cloudy and the temperature was in the mid-fifties. The water level at the time of the inspection was just below the spillway crest.

#### b. North Segment of Dam

There was concrete deterioration and removal in a number of areas on this segment of the dam. The most serious problem areas were as follows:

- a. The pier at the right end of the log sluice had tilted away from the dam (Photos 1 & 2). There was a void up to 2 feet wide between the pier and the dam.
- b. The wall supporting the left side of the stop log structure #1 was practically nonexistent (photos 3 & 4). The concrete had been completely removed on the lower portion of the intake structure.
- c. There has been extensive concrete removal on the wall supporting the right end of the stop log structure # 2 (photos 5 & 6). This wall was also being supported by reinforcing rods with complete removal of concrete in a section about two feet high in the middle of the wall.

In addition to these three areas, there was less serious concrete deterioration in several other areas. There was a void on the downstream slope of the spillway #1 along the first construction joint from the right hand end (photo 7). The concrete at the base of the pier at the right end of the log sluice was scoured, partially undermining the pier (photo #8). Finally, the concrete retaining wall at the right end of the segment was spalling and cracked (photo 9).

The remainder of this segment appeared to be in satisfactory condition. Except for the one void noted above, the spillway section was in good condition. The trash rack in front of stop log structure #1 was free of debris and well maintained.

Another deficiency noted was seepage emerging from the left wall adjacent stop log structure #2. The water was flowing through the rocks which formed the foundation for the old mill at this end of the segment (photo #10).

#### c. South Segment of Dam

Deteriorated concrete was the prime deficiency on this segment. A number of cracks and voids in the concrete were noted on the main spillway, section #3. There was leakage through several of the cracks (photo 11). Concrete on the intake of stop log structure #3 was deteriorated with reinforcing rod exposed and leakage through the left wall (photo 12). The intake of stop log structure #4 is in poor condition. There was significant concrete removal on the right wall at both the upstream and downstream ends (photos 13 & 14). Broken concrete slabs had been dumped beyond the left end of this structure to act as fill material in this area (photo 15).

The low-level outlet at the base of spillway #3 was blocked with stop logs but there was substantial leakage through the opening (photo 11). No other means of controlling flow through this outlet could be located.

d. Retaining Wall

The masonry and concrete wall which extends between the two segments of the dam was in satisfactory condition. The left end of the wall was entirely concrete and showed no signs of deterioration (photo 16). The right end of the wall was concrete over a masonry base. There was brush growing on both sides of the wall and two trees were growing just downstream (photo 17). One area of the wall had apparently failed and been repaired with new concrete (photo 18).

e. Appurtenant Structures-Croghan Island Mill

The mill and timber crib flume structure was in satisfactory condition. There was some leakage at the base of the flume near the point where it tied into the concrete stop log structure #3 (photos 19 & 20).

**3.2 EVALUATION OF OBSERVATIONS**

Visual observations revealed several deficiencies on this structure. The following items were noted:

1. The pier at the right end of the log sluice had tilted away from the dam.
2. Walls supporting the stoplog structures on either end of both spillway segments were seriously deteriorated.
3. There was concrete deterioration on both spillway segments, with the south segment having the most serious problems.
4. Concrete at the base of the pier at the right end of the log sluice was scoured.
5. The concrete retaining wall adjacent stop log structure #1 was spalling and cracked.
6. There was seepage through the left abutment wall adjacent stop log structure #2.
7. There was brush growing on both sides of the wall which connects the two segments of the dam.
8. The low-level outlet consisting of stop logs, at the base of spillway #3 was leaking.

## SECTION 4: OPERATION AND MAINTENANCE PROCEDURES

### 4.1 PROCEDURES

There are no prescribed operating procedures for this dam.

### 4.2 MAINTENANCE OF DAM

There is no established maintenance plan for the dam.

### 4.3 WARNING SYSTEM IN EFFECT

No apparent warning system for evacuation of downstream residents is present.

### 4.4 EVALUATION

The operation and maintenance procedures on this dam are not satisfactory. The deficiencies noted in section 3 indicate that increased maintenance efforts are needed.

## SECTION 5: HYDROLOGIC/HYDRAULIC

### 5.1 DRAINAGE AREA CHARACTERISTICS

The watershed contributing drainage to the dam site was determined from information for the stream gage located on the Beaver River approximately one-half mile downstream from the dam and from the USGS 7.5 minute quadrangle maps for Croghan and Belfort, New York.

The drainage area of over 293 square miles encompasses portions of the central and western slopes of the Adirondack Mountains. The rugged terrain has steep forested slopes and mountain peaks that rise to elevations at or above 2500 msl. The ground elevation adjacent the dam is at 825 msl. The Beaver River main stem originates some 50 miles upstream of the dam. Major tributaries to the Beaver River are the creeks named Murmur, Balsam, Fish, Alder, Moshier, and Birch plus Shingle Shanty Brook and Harrington Brook. Numerous lakes exist within the watershed, primarily in the upper half of the basin. The largest lakes are the Stillwater Reservoir, Lake Lila, and Nehasane Lake. In addition to these lakes, impoundments created by eight hydroelectric power dams on the Beaver River between this dam and the Stillwater Reservoir Dam further regulate flows in the river.

### 5.2 ANALYSIS CRITERIA

The analysis of the floodwater retarding capability of the dam was performed using the Corps of Engineers HEC-1 computer program, Dam Safety version. This program develops an inflow hydrograph using the "Clark Unit Hydrograph" method and then reservoir routs and channel routs the hydrograph using the "Modified Puls" flood routing procedure. The spillway design flood selected for analysis was the Probable Maximum Flood (PMF), in accordance with the Recommended Guidelines of the U.S. Army Corps of Engineers.

### 5.3 SPILLWAY CAPACITY

This run-of-river dam has two primary concrete gravity spillway sections which are separated by a concrete and masonry wall over 220 feet long. The right spillway located in the Beaver River main channel is comprised of a log sluice, three ungated overflow weirs, and two stop log structures. The left spillway located on a side channel from the river is comprised of a single ungated overflow weir flanked by two stop log structures. All spillway structures were analyzed for weir flow using a discharge coefficient, C, of 3.2.

Computed discharges for all site facilities are as follows:

Elevation above Spillway # 1	Water Level @:	D I S C H A R G E S		
		Left	Spillway Right	Total (cfs)
0	Base Flow	10	282	292
3.3	Top of 3 Stoplog Structures	1943	2254	4197
3.6	Top of Left Spillway Left Abutment Wall	2235	2325	4560
4.8	Top of Dam	2955	3076	6031

The flood analysis performed for this dam indicates that the spillway does not have sufficient capacity for discharging one-half the PMF. For this storm event, the peak inflow and peak outflow is 36,129 cfs. The PMF peak inflow and peak outflow is 73,351 cfs. The total discharge capacity of the spillways for a water surface at the top-of-dam is 6031 cfs.

#### 5.4 RESERVOIR CAPACITY

The reservoir at normal pool impounded by this dam lies primarily within the limits of the existing Beaver River channel; extending approximately 2.7 miles upstream to the High Falls Dam. The normal water surface is at or near the crest of spillway #1 (elev. 825). The impounded capacity for this elevation is 482 acre-feet. Surcharge storage capacity to the top-of-dam (elev. 829.8) adds 315 acre-feet for a total storage capacity of 797 acre-feet.

#### 5.5 FLOODS OF RECORD

The maximum known flood on the Beaver River occurred on May 21, 1968 when the nearby downstream USGS gage recorded a maximum discharge of 5100 cfs. For this flow, the computed water surface rises to approximately elevation 829.2.

#### 5.6 OVERTOPPING POTENTIAL

The highway bridge immediately upstream of the dam has not been overtopped within the past twenty years according to a local resident. The bottom flange of this steel bridge is at or near elevation 827.3.

Analysis using the PMF and one-half PMF storm events indicates that the dam does not have sufficient spillway capacity. The computed depths of overtopping for these two events are 15.84 feet and 8.49 feet respectively. All storm events exceeding 8% of the PMF will result in the dam being overtopped.

#### 5.7 EVALUATION

The spillway does not have sufficient capacity to discharge the peak outflow from one-half the PMF. For this storm event, a high tailwater condition would most likely occur, resulting in flooding of the downstream hazard areas. Dam failure would not significantly increase the hazard to loss of life downstream from that which would exist just before an overtopping induced failure. Therefore, the spillway capacity for this structure has been assessed as inadequate.

## SECTION 6: STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

#### a. Visual Observations

Visual observations revealed that there are a number of structural problems with this dam. The most serious deficiency was that one end of the log sluice structure was tilting downstream. It appeared to have separated from the dam, however, water flowing over the stop logs prevented a close inspection. There was a void up to 2 feet wide between the pier and the dam.

The other structural problems were the result of concrete deterioration. The worst deterioration was on the stop log structures at either end of both segments. There was complete removal of the concrete on two portions of two of the structures. The reinforcing rods were all that was supporting these portions. Concrete deterioration and leakage through several construction joints on the spillway sections was also noted.

#### b. Data Review and Stability Evaluation

Included in the 1918 Engineer's Report were the results of a stability analysis performed for the design of this dam. However, this analysis assumed no ice load and only 50% uplift pressure. The "Recommended Guidelines for the Safety Inspection of Dams" suggest an ice load of 5000 pounds per linear foot and full uplift pressure. Therefore, a separate stability analysis was performed for this report, based on the maximum spillway section shown on the plans.

The results of the analyses (see Appendix D) performed are as follows:

<u>CASE</u>	<u>OVERTURNING SAFETY FACTOR</u>	<u>RESULTANT IN MIDDLE THIRD</u>	<u>SLIDING SAFETY FACTOR</u>
a. Normal conditions; water surface at spillway crest	1.83	YES	1.14
b. Same as case a. plus ice load of 5,000 #/ft.	0.96	NO	0.57
c. Flood flows; water surface at top of dam	1.39	NO	0.68
d. 1/2 PMF flow; water surface 8.5 feet over top of dam	0.97	NO	0.39
e. Normal conditions with seismic coefficient of 0.10.	1.76	YES	0.83

The analyses indicates that the stability of this dam is deficient. The safety factor against sliding is below the recommended value even for a normal condition. For severe loading conditions, such as ice loading or flood flows, the analyses indicates that the dam is unstable.

Further investigations are required to better assess the stability of the structure. Subsurface explorations, to obtain data concerning the foundation bedrock and concrete cores are required. Stability analyses should then be performed using this data. Based on the results of these analyses, required modifications to the structure should be made.

c. Seismic Stability

This dam is located in Seismic Zone 2. Due to the location, a seismic stability analysis was performed in accordance with Corps of Engineers' Guidelines. The seismic analysis was performed for normal conditions with the water level at the spillway crest. The safety factors shown in the table on the previous page indicates the structure is unstable when subjected to earthquake loading.

## SECTION 7: ASSESSMENT/RECOMMENDATIONS

### 7.1 ASSESSMENT

#### a. Safety

The Phase I inspection of the Croghan Dam revealed a number of structural problems for this dam. Deteriorated and cracked concrete has resulted in a tilting pier on the log sluice, stop log structures which are supported only by reinforcing rods, and several leaks through the spillway section. Stability analyses indicate that the structure is unstable when subjected to severe loading conditions.

The spillway capacity is inadequate for the peak outflow from one-half the PMF. However, since downstream flooding could be expected prior to an overtopping induced failure, the spillway capacity is not considered to be seriously inadequate.

#### b. Adequacy of Information

The engineer's report and construction plans which were available for the preparation of this report were fairly complete and appeared to be reasonably accurate.

#### c. Need for Additional Investigations

Further investigation of the structural stability of this dam is required. The studies should include subsurface and structure investigations to obtain information about the condition of the structure and its foundation. This data should then be incorporated into a detailed stability evaluation.

#### d. Urgency

Investigations of the structural stability should be commenced within 6 months. Remedial measures deemed necessary both as a result of these investigations and to correct the other deficiencies should be completed within 18 months.

### 7.2 RECOMMENDED MEASURES

1. Modify the structure as necessary based on the stability analyses.
2. Repair the tilting pier at the right end of the log sluice.
3. Replace missing concrete on walls supporting the stop log structures on either end of both dam segments.
4. Repair deteriorated concrete on all spillway segments.
5. Repair scoured concrete at base of the pier at the right end of log sluice.
6. Repair spalled concrete on the retaining wall adjacent stoplog structure #1.
7. Investigate seepage through the left abutment wall adjacent to stop log structure #2.

8. Remove brush and trees growing on both sides of the wall which connects the two segments of the dam.
9. Repair the leaking low-level outlet at the base of the spillway # 3.
10. Develop an emergency action plan for the notification and evacuation of downstream residents.

APPENDIX A

PHOTOGRAPHS



Photo 1 Tilting Pier of Log Sluice on North  
Segment of Dam.



Photo 2 Tilting Pier at Right End of Log Sluice



Photo 3 Deteriorated Concrete and Exposed Re-bar at  
Right End of North Segment



Photo 4 Leakage Through Sidewall on Intake  
Structure at Right End of North Segment

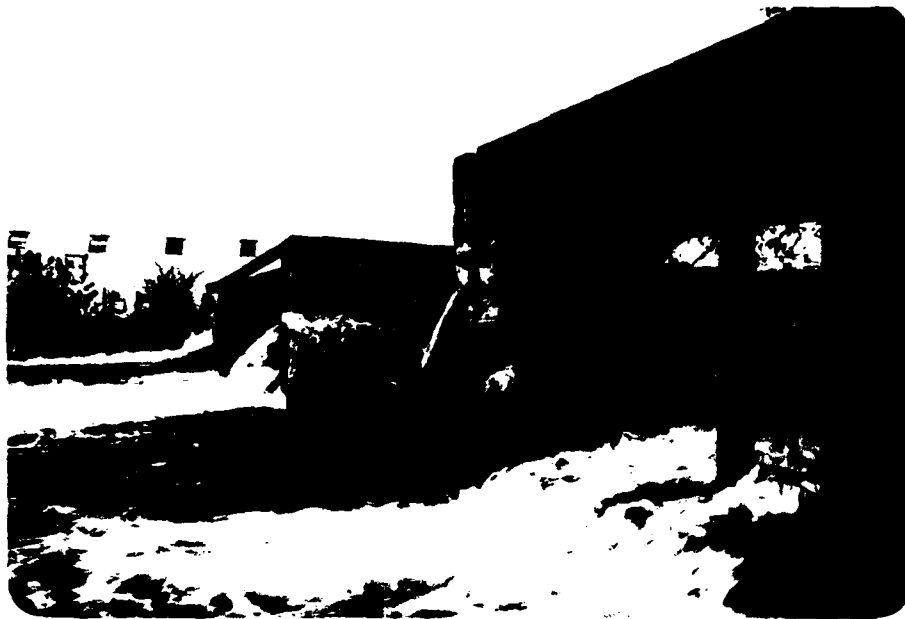


Photo 5 Intake Structure at Left End of North Segment  
Note Structure Being Supported by Re-bar.

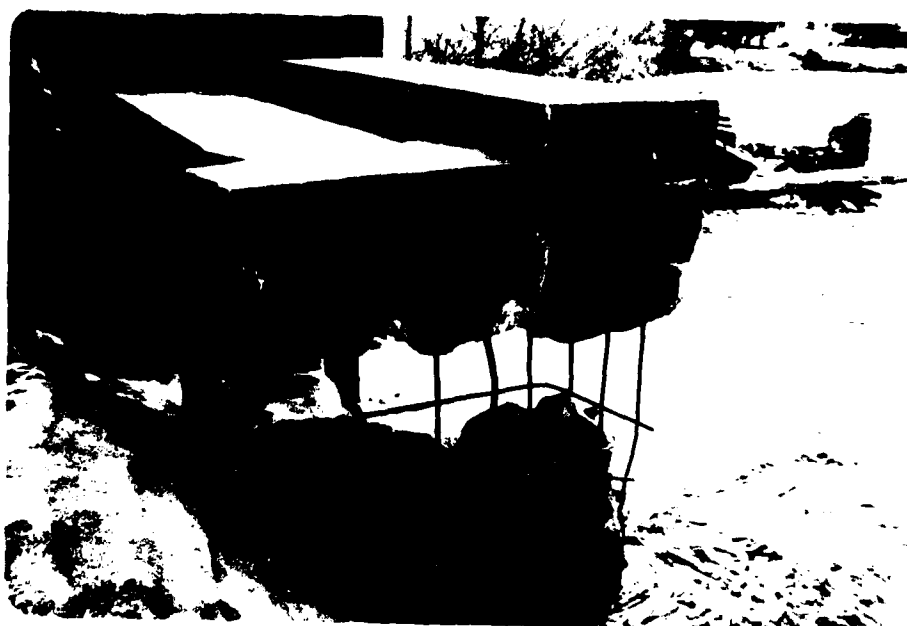


Photo 6 Deteriorated Concrete on Intake Structure at Left end  
of North Segment



Photo 7 - Deteriorated Concrete and Void along  
Construction joint on North Segment



Photo 8-Scoured Concrete at Base of Left  
Pier to Log Sluice on North Segment



Photo 9-Spalled and Deteriorated Concrete  
at Right End of North Segment



Photo 10 Seepage Emerging From Left  
Abutment of North Segment



Photo 11-South Spillway Segment-Note Crack and Seepage near Crest and Leakage through Center Stop Log Orifice



Photo 12 Deteriorated Concrete and Leakage Through Intake Structure at Right End of South Segment



Photo 13 Deteriorated Concrete on Intake  
Structure at Left End of South Dam



Photo 14 Downstream View of Intake Structure  
at Left End of South Dam



Photo 15 Broken Concrete Dumped Beyond  
Left End of South Segment



Photo 16 Wall which Connects North  
and South Segments of the Dam



Photo 17 Wall Which Connects Two Segments  
Note Brush Growing on Both Sides of Wall



Photo 18 Wall Connecting Two Segments; Note Trees Growing  
Downstream of Wall



Photo 19 - Flume Leading to Remaining Operating  
Mill on South Dam



Photo 20 Leakage at Base of Flume  
Structure Leading to Lumber Mill

APPENDIX B

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST1) Basic Data

## a. General

Name of Dam CROGHAN DAM-NORTH & SOUTHFed. I.D. # 694 DEC Dam No. 112A-340River Basin BLACK RIVERLocation: Town CROGHAN County LEWISStream Name BEAVER RIVER

Tributary of \_\_\_\_\_

Latitude (N) 43° 53.8' Longitude (W) 75° 023.5'Type of Dam CONCRETE GRAVITYHazard Category CDate(s) of Inspection 10/15/80Weather Conditions 55° PARTLY CLOUDYReservoir Level at Time of Inspection AT SPILLCRESTb. Inspection Personnel R. WARRENDER W. LYNICK

c. Persons Contacted (Including Address &amp; Phone No.) \_\_\_\_\_

MR. ELMER GOLDENBEAVERITE PROD. CO.CROGHAN, N.Y. 13327(315) 346-6011CROGHAN ISLAND MILL LUMBER CO.BRIDGE STREETCROGHAN, N.Y. 13327(315) 346-1115

## d. History:

Date Constructed 1918 Date(s) Reconstructed \_\_\_\_\_Designer JAMES P. BROWNELL, CARTHAGE, N.Y.Constructed By H.J. WRIGHT, WATERTOWN, N.Y.Owner MULTIPLE OWNERSHIP

SECTION 2 WAS ELIMINATED SINCE THERE WAS NO  
EMBANKMENT SECTION ON THIS STRUCTURE.

3) Drainage System

a. Description of System NONE

b. Condition of System \_\_\_\_\_

c. Discharge from Drainage System \_\_\_\_\_

4) Instrumentation (Monumentation/Surveys, Observation Wells, Weirs,  
Piezometers, Etc.) \_\_\_\_\_

STAFF GAGE AT NORTH ABUTMENT WALL NEAR  
BEAVERITE PRODUCTS

5) Reservoir

- a. Slopes MAIN CHANNEL OF BEAVER RIVER
- b. Sedimentation NO PROBLEMS EVIDENT
- c. Unusual Conditions Which Affect Dam HIGHWAY BRIDGE UPSTREAM OF DAM COULD INHIBIT FLOWS TO DAM

6) Area Downstream of Dam

- a. Downstream Hazard (No. of Homes, Highways, etc.) 3 HOUSES PLUS LUMBER YARD ON ISLAND
- b. Seepage, Unusual Growth NONE
- c. Evidence of Movement Beyond Toe of Dam NONE
- d. Condition of Downstream Channel ROCK BED

7) Spillway(s) (Including Discharge Conveyance Channel)

2 MAIN SPILLWAY SEGMENTS EACH WITH STOP LOG<sup>INTAKE</sup> STRUCTURES AT EITHER END

- a. General DETERIORATED CONCRETE THROUGH OUT - MINOR CRACKS AND SEEPAGE THROUGH THE CONSTRUCTION JOINTS ON BOTH SPILLWAY SECTIONS - PROVISIONS FOR <sup>FLASH BOARDS</sup> ~~STOP LOGS~~ ON SPILLWAY SECTION

- b. Condition of NORTH Spillway CONSISTS OF LOG SLUICE, & 2 INTAKE STRUCTURES, & MAIN SPILLWAY SECTION

LOG SLUICE - RIGHT END IS TILTED & REMOVED FROM DAM - OPENED A VOID UP TO 2 FEET DEEP, LEFT END INTACT ALTHOUGH THERE IS SCOUR AT BASE

RIGHT INTAKE STRUCTURE - CONCRETE SERIOUSLY DETERIORATED - REBAR IS ALL THAT SUPPORTS LEFT END OF WALL - LEAKAGE THROUGH WALL AT LEFT END  
LEFT INTAKE STRUCTURE - REBAR IS ALL THAT IS LEFT ON LOWER PORTION OF WALL OVERALL DETERIORATION AS WELL.

c. Condition of ~~Auxiliary~~ <sup>SOUTH</sup> Spillway CONSISTS OF 2 INTAKE STRUCTURES & MAIN SPILLWAY  
RIGHT INTAKE STRUCTURE - (TO LUMBER MILL) - SOME DETERIORATED CONCRETE ON  
SPILLWAY SIDE PERMITTING LEAKAGE THROUGH CONCRETE - SOME EXPOSED REBAR  
LEFT INTAKE STRUCTURE - SERIOUSLY DETERIORATED CONCRETE - SOME SCOURING  
ON END NEAR SPILLWAY - REBAR EXPOSED ON DOWNSTREAM END

d. Condition of Discharge Conveyance Channel \_\_\_\_\_

SATISFACTORY

8) Reservoir Drain/Outlet ON SOUTH SPILLWAY SECTION

Type: Pipe \_\_\_\_\_ Conduit \_\_\_\_\_ Other STOP LOG ORIFICE  
AT BASE OF SPILLWAY

Material: Concrete \_\_\_\_\_ Metal \_\_\_\_\_ Other \_\_\_\_\_

Size: 4.5' WIDE X 5' HIGH Length \_\_\_\_\_

Invert Elevations: Entrance \_\_\_\_\_ Exit \_\_\_\_\_

Physical Condition (Describe): \_\_\_\_\_ Unobservable \_\_\_\_\_

Material: \_\_\_\_\_

Joints: \_\_\_\_\_ Alignment \_\_\_\_\_

Structural Integrity: \_\_\_\_\_

Hydraulic Capability: \_\_\_\_\_

Means of Control: Gate \_\_\_\_\_ Valve \_\_\_\_\_ Uncontrolled \_\_\_\_\_

Operation: Operable \_\_\_\_\_ Inoperable \_\_\_\_\_ Other \_\_\_\_\_

Present Condition (Describe): LEAKING THROUGH STOP LOGS

9) Structural

- a. Concrete Surfaces DETERIORATED THROUGHOUT - MORE DETERIORATION ON INTAKE STRUCTURES THAN ON MAIN SPILLWAY SECTIONS  
SPALLING ON RETAINING WALL AT RIGHT END OF NORTH DAM
- b. Structural Cracking SOME CRACKS ON SOUTH SPILLWAY SECTION  
NEAR CREST-LEAKAGE THROUGH THESE CRACKS
- c. Movement - Horizontal & Vertical Alignment (Settlement) \_\_\_\_\_
- d. Junctions with Abutments or Embankments \_\_\_\_\_  
OKAY
- e. Drains - Foundation, Joint, Face \_\_\_\_\_  
NONE
- f. Water Passages, Conduits, Sluices SERIOUS CONCRETE DETERIORATION ON ALL OF THE STOPLOGGED INTAKE STRUCTURES
- g. Seepage or Leakage SOME NOTED COMING THROUGH STONES AT BASE OF LEFT ABUTMENT OF NORTH SEGMENT OF THE DAM.

- h. Joints - Construction, etc. SEPARATION & DETERIORATION  
ALONG SEVERAL OF CONSTRUCTION JOINTS
- i. Foundation OKAY
- j. Abutments
- k. Control Gates NONE
- l. Approach & Outlet Channels OKAY
- m. Energy Dissipators (Plunge Pool, etc.) NONE
- n. Intake Structures DETERIORATED CONCRETE WITH REBAR  
EXPOSED ON ALL STRUCTURES
- o. Stability
- p. Miscellaneous - WALL BETWEEN SPILLWAY SEGMENTS - CONCRETE  
PATCHED IN SPOTS BUT IN GOOD CONDITION - SOME BRUSH  
GROWING ON EITHER SIDE OF WALL - TWO TREES DOWNSTREAM  
OF WALL - RIGHT UP AGAINST IT.

10) Appurtenant Structures (Power House, Lock, Gatehouse, Other)

## a. Description and Condition

CROGHAN ISLAND MILL - FLUME CONSTRUCTED OF  
TIMBERS LEADING FROM RIGHT INTAKE  
STRUCTURE AT SOUTH DAM TO MILL - SOME  
LEAKAGE NOTED AT BASE OF TIMBERS CRIB

11) Operation Procedures (Lake Level Regulation):

APPENDIX C

HYDROLOGIC/HYDRAULIC  
ENGINEERING DATA AND COMPUTATIONS

CROGHAN DAM  
NY-694

1

CHECK LIST FOR DAMS  
HYDROLOGIC AND HYDRAULIC  
ENGINEERING DATA

AREA-CAPACITY DATA:

	(RELATIVE) <u>Elevation</u> (ft.)	<u>Surface Area</u> (acres)	<u>Storage Capacity</u> (acre-ft.)
1) Top of Dam	<u>4.8</u>	<u>          </u>	<u>797</u>
2) Design High Water (Max. Design Pool)	<u>N/A</u>	<u>          </u>	<u>          </u>
3) Auxiliary Spillway Crest	<u>N/A</u>	<u>          </u>	<u>          </u>
4) Pool Level with Flashboards	<u>N/A</u>	<u>          </u>	<u>          </u>
5) Service Spillway Crest	<u>0.0</u>	<u>          </u>	<u>482</u>

DISCHARGES

	<u>Volume</u> (cfs)
1) Average Daily ( $\approx$ BASE FLOW)	<u><math>\pm 300</math></u>
2) Spillway @ Maximum High Water (SPILLWAY 1, 2, 3)	<u><del>6031</del> 4308</u>
3) Spillway @ Design High Water	<u>N/A</u>
4) Spillway @ Auxiliary Spillway Crest Elevation	<u>N/A</u>
5) Low Level Outlet	<u>N/A</u>
6) Total (of all facilities) @ Maximum High Water	<u>6031</u>
7) Maximum Known Flood	<u><math>\pm 5100</math></u>
8) At Time of Inspection	<u><math>\pm 300</math></u>

## CREST:

(RELATIVE)  
ELEVATION: 4.8

Type: CONCRETE AND/OR CONCRETE-MASONRY WALL

Width: VARIES 2' - 3' Length:  $\approx 300'$ 

Spillover 2 SPILLWAY SECTIONS SEPARATED BY WALL

Location EITHER END OF DAM ; WALL SEPARATES THE SPILLWAYS

## SPILLWAY:

LEFT

RIGHT

SPILLWAY #3 0.0	(RELATIVE) Elevation	SPILLWAY #2 0.0	SPILLWAY #1 0.0
OVERFLOW WEIR	Type	OVERFLOW WEIR w/ CENTER PIER	OVERFLOW WEIR
2'+	Width	2'+	2'+
Type of Control			
✓	Uncontrolled	✓	✓
Controlled:			
N/A	Type (Flashboards; gate)	N/A	N/A
—	Number	—	—
107'	/Length	26.5'	46.5'
CONCRETE	Invert Material	CONCRETE	CONCRETE
Anticipated Length of operating service			
N/A	Chute Length	N/A	N/A
N/A	Height Between Spillway Crest & Approach Channel Invert (Weir Flow)	N/A	N/A

- a) 2 STOPLOG  
STRUCTURES:  
w/ 14' WEIR LENGTHS  
(EACH)  
  
ONE EACH SIDE OF  
SPILLWAY #3

ADDITIONAL DISCHARGE  
FACILITIES

- a) 2 STOPLOG STRUCTURES:  
w/ 16' & 14' WEIR  
LENGTHS  
  
ONE ON EITHER  
END OF THIS SPILLWAY
- b) LOG SLUICE 33.5' LONG  
BETWEEN SPILLWAY #1  
& SPILLWAY #2

CROGHAN DAM 3  
NY-694

HYDROMETEROLOGICAL GAGES: [ HUDSON RIVER - BLACK RIVER  
REGULATING DISTRICT

Type : STAFF GAGE

USGS #04258000  
WATER-STAGE RECORDER

Location: ON RIGHT ABUTMENT WALL  
150' UPSTREAM OF STOPLOG STRUCT. #1

± 1/2 MILE DOWNSTREAM OF  
DAM SITE ; ON BEAVER RIVER

Records:

Date - UNKNOWN

9/1930 TO PRESENT

Max. Reading - UNKNOWN

5/21/1969 → 5100 cfs

FLOOD WATER CONTROL SYSTEM:

Warning System: N/A

Method of Controlled Releases (mechanisms):

NONE APPARENT ; STOPLOG REMOVAL IS POSSIBLE  
SPILLWAY #3 LOW-LEVEL OPENING

DRAINAGE AREA: 293.1 SQ MI. or 187,584 ACRES

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: UNDEVELOPED ; OPEN FIELDS & FORESTS

Terrain - Relief: STEEP SLOPES ; ADIRONDACK MTNS.

Surface - Soil: VERY STONY

Runoff Potential (existing or planned extensive alterations to existing  
(surface or subsurface conditions)

N/A  
\_\_\_\_\_  
\_\_\_\_\_

Potential Sedimentation problem areas (natural or man-made; present or future)

N/A  
\_\_\_\_\_  
\_\_\_\_\_

Potential Backwater problem areas for levels at maximum storage capacity  
including surcharge storage:

NONE APPARENT  
\_\_\_\_\_  
\_\_\_\_\_

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the  
Reservoir perimeter:

Location: N/A

Elevation: \_\_\_\_\_

Reservoir:

Length @ Maximum Pool 2.7 (Miles)

Length of Shoreline (@ Spillway Crest) \_\_\_\_\_ (Miles)

BEAVER RIVER FLOWS REGULATED BY STILLWATER RESERVOIR DAM  
AND 8 OTHER HYDRO-POWER DAMS LOCATED BETWEEN CROGHAN  
DAM & STILLWATER RESERVOIR

PROJECT GRID

JOB CROGHAN DAM		NY-694 DEC # 340 BLACK	SHEET NO. 1/	CHECKED BY	DATE
SUBJECT WATERSHED PARAMETERS				COMPUTED BY WCL	DATE 12/12/80

USGS GAGE #04258000 — BEAVER RIVER @ CROGHAN	
DRAINAGE AREA = 294 SQ. MI.	PLANIMETERED AREA: (UPSTREAM OF GAGE)
DEDUCT = 0.9 SQ. MI.	QUAD AREA (IN <sup>2</sup> )
	CROGHAN 4.11
	BELFORT 2.12
CROGHAN DAM — DRAINAGE AREA	6.23 IN <sup>2</sup> = 572 ACRES
USE → 293.1 SQ. MI.	1.0 IN <sup>2</sup> = 91.827 ACRES

DRAINAGE AREA TO STILLWATER RESV. DAM:	
USGS GAGE #04256500 — @ DAM	DA = 172 SQ. MI.
PHASE I INSP. REPORT FOR STILLWATER 9/78 NY-316 RESV. DAM	DA = 178 SQ. MI. ← USE

DRAINAGE AREA BETWEEN 2 DAMS = 115.1 SQ. MI.	
--	--

PROJECT GRID

JOB CROGHAN DAM	NY-694	SHEET NO. 2/	CHECKED BY	DATE
SUBJECT WATERSHED PARAMETERS			COMPUTED BY WCL	DATE 12/12/80

CLARK HYDROGRAPH PARAMETERS:

REF: BLACK RIVER BASIN STUDY - CE-BUFFALO DIST. 6/74

$$\log(TC) = 1.2874 + 0.2035 \log(DA) - 0.7675 \log(S) + 0.2707 \log(L)$$

$$\log(TC+R) = 1.5449 - 0.31 \log(DA) - 0.5991 \log(S) + 0.8787 \log(L)$$

{

L = 22.46 MILES [BEAVER RIVER MAIN STEM TO STILLWATER RES.]

DA = 115.1 SQ MI.

S = 36.95 FT/MI. =  $\frac{1640 - 810}{22.46}$

$$\log(TC) = 1.2874 + 0.4194 - 1.2031 + 0.3658 = 0.8695$$

TC = 7.40 HRS

$$\log(TC+R) = 1.5449 - 0.6389 - 0.9392 + 1.1875 = 1.1543$$

TC + R = 14.27 → R = 6.87

SOIL INFILTRATION RATES:

REF: SOILS OF NEW YORK LANDSCAPES 8/77 ED. (MAP)

SOIL SYMBOL	NAME	SCS GROUP	SUBBASIN LOCATION	
			ST. R.	CROGHAN
Ds	CHARLTON	B		✓
	PAXTON	C		✓
	ESSEX	C		✓
Kd	ADAMS	A		✓
	COLTON	A		✓
Fs 1	BECKET	C	✓	✓
	BERKSHIRE	B	✓	✓
	POTSDAM	B	✓	✓

VERY STONY

INITIAL LOSS = 1.0 INS.  
(BOTH)

RATE: 0.2

0.1

← USE

PROJECT GRID

JOB CROGHAN DAM NY-694		SHEET NO. 3/	CHECKED BY	DATE
SUBJECT WATERSHED PARAMETERS			COMPUTED BY WCL	DATE 12/12/80

BASE FLOW:

REF: USGS/NYS DEC - BULL. # 74 (1979):

GAGE ON BEAVER RIVER NEAR CROGHAN: DA  $\approx$  290  $\pm$  SQ MI.

7 READINGS ( 9/5/20 TO 7/10/21 ) AVE = 337 CFS  $\rightarrow$  1.16 CSM

BASE FLOW = 1 CSM  $\leftarrow$  USE

RAINFALL — PMP

REF: NWS - HRR #33 (4/1956):

INDEX PMP = 18.5" FOR 200 SQ MI - 24 HR (ZONE #1)

ADJUSTMENT FOR DA & DURATION:

	DURATION $\rightarrow$ HRS			
	6	12	24	48
% OF INDEX	69	84	95	101
PRECIP. AMT.	= 12.76	15.54	17.58	18.68

IMPERVIOUS AREAS WITHIN SUBBASINS: (FROM USGS MAPS)

STILLWATER RESV. SUBBASIN: DA = 178 SQ MI

STILLWATER RESV	=	10.5 SQ MI.	} 7.7% $\rightarrow$ 0.077
NEHASANE LAKE	=	0.63	
LAKE LILA	=	2.07	
SALMON LAKE	=	0.49	
		13.74 SQ MI	

\*\*\*\*\*  
 W-C-1 VERSION DATED JAN 1973  
 UPDATED AUG 74  
 CHANGE NO. 01  
 \*\*\*\*\*

PMF ROUTING-CREST EL 1679.3  
 STILLWATER RESERVOIR DAM  
 O. ARIEN + GENE - JUSTIN + COURTNEY DIV

JUN SPECIFICATION  
 NO NHQ MMH IDAY THS TWIN WFIRC IFLT IPPT NSTAN  
 01 2 0 1 0 0 0 0 0 2 0  
 JNPER NWI 5 0

MULTI-PLAN ANALYSES TO BE PERFORMED

RTTOS= .10 .20 .30 .40 .50 .60 .70 .80 1.00  
 NPLAN= 1 NPTIO= 3 LPTIO= 1

SUB-AREA RUNOFF COMPUTATION

ISIAO IGOMP IEGON IFAPE JPLT JPRT INAME  
 1 0 0 0 0 1 0 0

HYDROGRAPH DATA

SNAP TQSTA TRSPO RATIO ISNOW ISAME LOCAL  
 0 1 176.00 0.00 0.00 0.00 0.000 0 0 0

PRECIP DATA

NO STORM DAI DAX  
 6 0.00 0.00 0.00

LOSS DATA

STPKS STPKS RTTOK STETL CHSTL ALSHX RTTAP  
 0.00 0.00 1.00 0.00 0.00 0.10 0.00 0.00

UNIT HYDROGRAPH DATA

TP= 10.00 CP= .63 NTA= 0

RECESSION DATA

STPTQ= 0.00 OPSSN= 9.00 RTTOD= 1.00  
 APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNOVFO CP AND TO APT TC= 6.31 AND R= 4.90 INTERVALS

UNIT HYDROGRAPH 30 END-OF-PEAK COEFFICIENTS. LAG= 19.74 HOURS. CP= .53 VOL= 1.00  
 475. 1710. 3402. 5041. 6243. 5702. 6170. 5107. 4161. 3390.  
 2752. 2250. 1433. 1217. 931. 407. 659. 516. 437. 339.  
 356. 236. 172. 157. 128. 104. 45. 69. 56.

END-OF-PEAK FLOW

TIME RAIN EXCS COMP 3  
 . 2 . 0 . 0 . 0

AC-FT

30197.

71604.

94611.

94619.

## HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 1

259.	1059.	3147.	22754.	31612.	56340.	69174.	72316.	67828.
57319.	27032.	31673.	25079.	21076.	17110.	13056.	11170.	9263.
7546.	5004.	4091.	3124.	2703.	2206.	1748.	1464.	1193.
953.	752.	141.	27.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.

JFS

72310.

69446.

45441.

18153.

TOTAL VOLUME

INCHES

3.63

4.58

11.19

10116.

## HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 9

255.	1323.	1314.	28442.	49614.	70425.	85217.	90420.	94785.
72394.	59622.	48506.	32599.	32261.	26283.	21412.	17445.	14212.
4033.	7545.	4261.	5101.	4155.	3345.	2758.	2247.	1931.
1148.	940.	683.	176.	34.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.

JFS

90420.

56837.

57104.

27704.

TOTAL VOLUME

INCHES

4.54

14.98

14.24

135170.

A-31

## HYDROGRAPH ROUTING

STAG	ICOMP	TECH	ITAF	JPLT	JORT	INAME
2	1	0	0	0	0	0

## ROUTING DATA

QLOSS	CLOSS	AVG	IPFS	ISAME
0.0	0.000	0.00	1	1

NSTPS	NSINL	LAG	AMSKX	X	YSK	STORA
1	0	0	0.000	0.000	0.000	-1.

STORAGE=	0.	14103.	23119.	45513.	63002.	81640.	101936.	122392.	0.	0.
OUTFLOW=	0.	5750.	12914.	22215.	31193.	54116.	83180.	118440.	0.	0.

24.	32.	47.	96.	223.	463.	824.	1279.	1768.	2225.
2593.	2954.	3121.	3112.	3143.	3123.	3091.	3006.	2911.	2807.
2093.	2571.	2450.	2327.	2206.	2095.	1970.	1858.	1750.	1647.
1564.	1454.	1364.	1278.	1195.	1117.	1044.	976.	912.	851.
777.	745.	696.	651.	609.	569.	532.	497.		

70.	78.	115.	216.	545.	1114.	2019.	3112.	4331.	5449.
6350.	6301.	7400.	7622.	7633.	7566.	7545.	7363.	7116.	6876.
6645.	6321.	6302.	5701.	5432.	5113.	4826.	4551.	4286.	4011.
3791.	3561.	3341.	3130.	2927.	2716.	2558.	2391.	2235.	2089.
1952.	1725.	1706.	1595.	1470.	1333.	1192.	1071.		

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
3143.	1128.	2910.	1961.	75042.
JFS	1652.	5776.	11675.	17410.
INCHES	1.16	3.61	1.23	
AC-FT				

SUBJECT	SHEET	BY	DATE	JOB NO
STILLWATER RESERVOIR DAM	7	RE	6/19/78	

Checked DBC

STAGE - STORAGE

Surface area @ Spillway Crest = 6720 Ac (Elev 1679.3)

Surface area @ Elev 1700 = 12698 Ac

Assume area varies linearly with stage

$$\therefore \frac{5977.6}{20.7} = 288.8 \text{ Ac/Ft}$$

$$A = 288.8d + 6720 \quad d = 0 @ 1679.3$$

$$S = 144.4 d^2 + 6720d \text{ (above Spillway Crest)}$$

From Water Resources Data  
for NY

Sta	Ac	Inc Stor (AcFt)	Accum Stor (AcFt)	(AcFt) Accum Storage
1658		13866	13866	
1660		14982	18848	
1665		16001	34849	
1670		20959	55808	
1675		25826	81634	
1680		31222	112856	0 @ 1679.3
1681.3	7298		122,502	14018
1683.3	7875		137,675	29190
1685.3	8453		154,002	45518
1687.3	9030		171,487	63002
1689.3	9608		190,125	81640
1691.3	10186		209,919	101434

SUBJECT	SHEET	BY	DATE	JOB NO
STILLWATER RESERVOIR DAM	6	REN	6/16/70	

Elev - DISCHARGE (cfs)

Elev	Q <sub>gates</sub>	Q <sub>spillways</sub>	Q <sub>overtopping</sub>	Q <sub>total</sub>
1679.3	0*	0	0	0
1681.3	1864	3896	0	5760
1683.3	1918	11020	0	12938
1685.3	1971	20245	0	22216
1687.3	2024	31169	0	33193
1689.3	2071	43560	8485	54116
1691.3	2119	57261	24000	83380

\* Assume gates are opened at the beginning of PMF

PROJECT GRID

JOB CROGHAN DAM	SHEET NO. 4/	CHECKED BY	DATE
SUBJECT STORAGE CAPACITY		COMPUTED BY WCL	DATE 12/15/80

RESERVOIR STORAGE VOLUME :

REF: 7.5 MIN UEGS QUAD - CROGHAN :

$L \approx 14330'$  UPSTREAM TO HIGH FALLS DAM (TAILWATER)

RIVER WIDTH (AVE.)  $\approx 200'$

$\Delta \text{ELEV} \approx 4' = (829 - 825)$  FOR WATER SURFACE SLOPE

CHANNEL BOTTOM SLOPE  $\approx$  WATER SURFACE SLOPE

$S = 0.00027913 = \frac{4}{14330}$

HT DAM = 10'

$h = 4'$

$L = 14330'$

$A = L \times 200' = 2866000 \text{ FT}^2 = 65.794 \text{ ACRES}$

$\text{Vol} = \frac{1}{3} A h$

$\text{Vol} = 87.7 \text{ A-F}$   $h : 0-4' \text{ ABOVE BOTTOM}$   $(H = -6)$

$\Delta \text{Vol} = 65.8 \text{ A-F/FT DEPTH}$   $h = 4' - 10'$

FOR 10' DAM : VOL = 482 A-F @ CREST OF SPILLWAY #1  $(H = 0)$

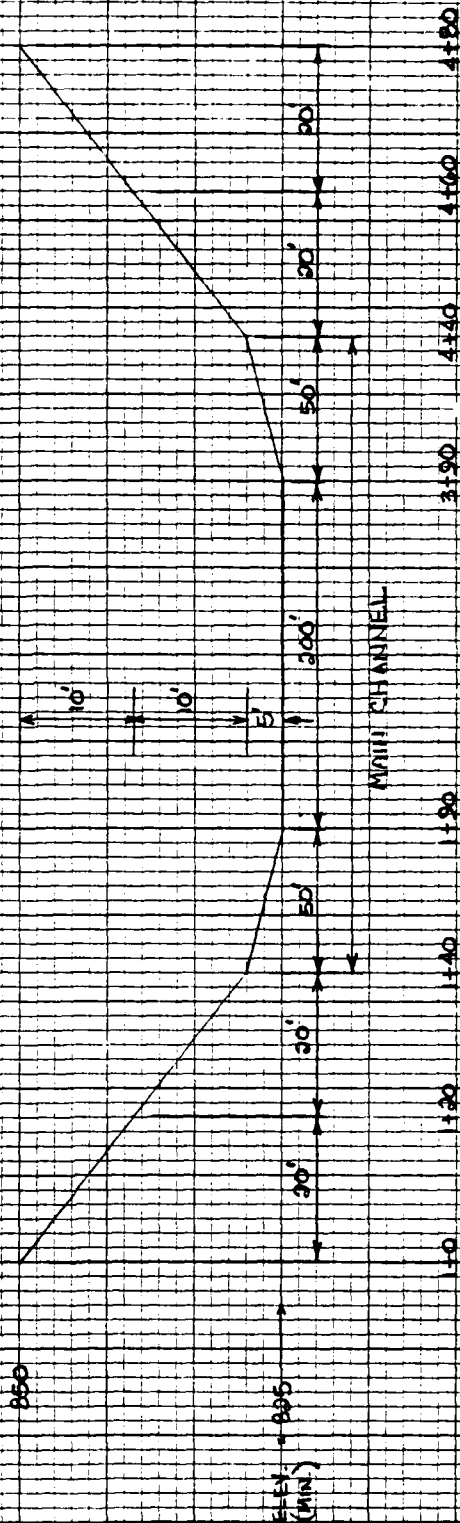
$4.8 \times 65.8 = +315 \rightarrow 797 \text{ A-F}$   $(H = 4.8)$

AA/

CROGHAN DAM NY-694

X-SECTION USED FOR BEAVER RIVER  
(STILLWATER RES. TO CROGHAN)

(HEC-1 CHANNEL ROUTING)



$$\text{SLOPE} = \frac{1640 - 895}{11800} = 0.00687$$

$$\text{USE } n = 0.045$$

PROJECT GRID

JOB CROGHAN DAM		SHEET NO. 5/		CHECKED BY		DATE	
SUBJECT BASE FLOW - DISCHARGES				COMPUTED BY WCL		DATE 12/16/80	
BASE FLOW $Q = 293 \text{ cfs}$ (SHT 3/)							
@ TIME OF INSPECTION - SITE DISCHARGE $\approx$ BASE FLOW							
FLOW OCCURRING THRU FOUR STOPLOG STRUCTURES + LOG SLUICE							
$Q = CLH^{3/2}$ USE $C = 3.2$							
STRUCTURE $\rightarrow$	STOPLOG #1	STOPLOG #2	STOPLOG #3	STOPLOG #4	LOG SLUICE		
L =	16	14	14	14	29		
DIST. BELOW CREST OF SPILLWAY #1 = H = 0.35							
	0.75	0.05	0.05	1.9 $\pm$			
(MEASURED)							
$Q = CLH^{3/2}$	(cfs)	10.6	29.1	5	5	243	
$\therefore$ USE THE ABOVE H VALUES TO SET THE RESPECTIVE CREST ELEVATIONS							
AT TIME OF INSPECTION WATER SURFACE WAS AT CREST OF PRIMARY SPILLWAYS (1 & 2)							

TOTAL  
292.7

PROJECT GRID

JOB CROGHAN DAM				SHEET NO. 6/		CHECKED BY		DATE	
SUBJECT SPILLWAY DISCHARGES						COMPUTED BY WCL		DATE 12/17/80	

SPILLWAY #1		$Q = CLH^{3/2}$		SPILLWAY #2	
$L' = 46.5'$	$C = 3.2$	$L = L' - 2(NK_p + K_o)H$		$L' = 24'$	$N = 1$
ABUTMENT CONTRACTION FOR $H = 0$ TO $3.3'$		$N = 0$		$C = 3.2$	$K_p = 0.02$
NO ABUTMENT CONTRACTION FOR $H = 3.3'$ & ABOVE		$K_o = 0.2$		ABUTMENT & PIER CONTRACTION FOR $H = 0$ TO $3.3'$	
				NO CONTRACTION FOR $H = 3.3'$ & ABOVE	
$C = 3.2$	$L = 46.5 - 0.4H$	ELEVATION		$L = 24 - 0.4H$	$C = 3.2$
(cfs)		CREST = 0			(cfs)
Q	L	H		L	Q
→	46.5	0		24	→
13	46.42	0.2		23.91	6
52	46.3	0.5		23.78	26
147	46.1	1		23.56	75
269	45.9	1.5		23.34	137
413	45.7	2		23.12	209
575	45.5	2.5		22.90	289
753	45.3	3		22.68	377
866	45.18	3.3		22.55	432
879 = 13 + 866	L	$\Delta H$		$\Delta H$	L
	46.5	0.2		0.2	26.5
890	24 +	0.3		0.3	
		3.6			
953	87 +	0.7		0.7	
		4			
1061	195 +	1.2		1.2	
		4.5			
1139 = 273 + 866	46.5	1.5		1.5	26.5
		4.8			432
					+ 155 = 587

(ASSUME  
USGS  
825.0 →

PROJECT GRID

JOB CROGHAN DAM				SHEET NO. 7/		CHECKED BY		DATE	
SUBJECT SPILLWAY DISCHARGES						COMPUTED BY WCL		DATE 12/17/80	

SPILLWAY #3		$Q = CLH^{3/2}$		LOG SLUICE			
$L = L' - 2(NK_p + K_g)H$		$L = L' - 2(NK_p + K_g)H$		$L = L' - 2(NK_p + K_g)H$			
$L' = 107' \quad N=0 \quad K_g=0.2$		$L' = 29' \quad N=0 \quad K_g=0.2$		$L' = 29' \quad N=0 \quad K_g=0.2$			
$L = 107 - 0.4H$		$L = 29 - 0.4H$		$L = 29 - 0.4H$			
2-ABUTMENT CONTRACTIONS		H = 0.2 TO 3.3		2-ABUTMENT CONTRACTIONS		H TO 3.3	
1-ABUTMENT CONTRACTION		H = 3.3 TO 3.6		NO ABUTMENT CONTRACTION		H ABOVE 3.3	
NO ABUTMENT CONTRACTION		H = 3.6 & ABOVE		INITIAL FLOW = 243 cfs (SHT 5/)			
$C=3.2$ (cfs)		ELEVATION CREST=0		$C=3.2$ (cfs)			
$Q$	$L$	$H$	$L$	$Q$			
825.0	107	0	29	243			
	107	0.2	28.92	243 + 8 = 251			
	ΔH						
56	106.88	0.3	28.8	+ 30 = 275			
244	106.68	0.8	28.6	+ 91 = 334			
505	106.48	1.3	28.4	+ 166 = 409			
821	106.28	1.8	28.2	+ 255 = 498			
1184	106.08	2.3	28	+ 354 = 597			
1587	105.88	2.8	27.8	+ 462 = 705			
1847	105.76	3.1	27.68	243 + 530 = 773			
	(L=107-0.2H)		ΔH				
2039	106.34	3.3	0.2	33.5	9	+ 1	= 782
2132	106.32	3.4	0.3		17	+ 1	= 790
2218 = 86 +	L	ΔH					
	107	0.4	4	0.7	62	+ 1	= 835
2424 = 292 +							
	107	0.9	4.5	1.2	140	+ 1	= 913
2582 = 450 + 2132	107	1.2	4.8	1.5	33.5	196	+ 773 = 969

PROJECT GRID

JOB CROGHAN DAM		SHEET NO. 8/		CHECKED BY		DATE	
SUBJECT SPILLWAY DISCHARGES				COMPUTED BY WCL		DATE 12/17/80	

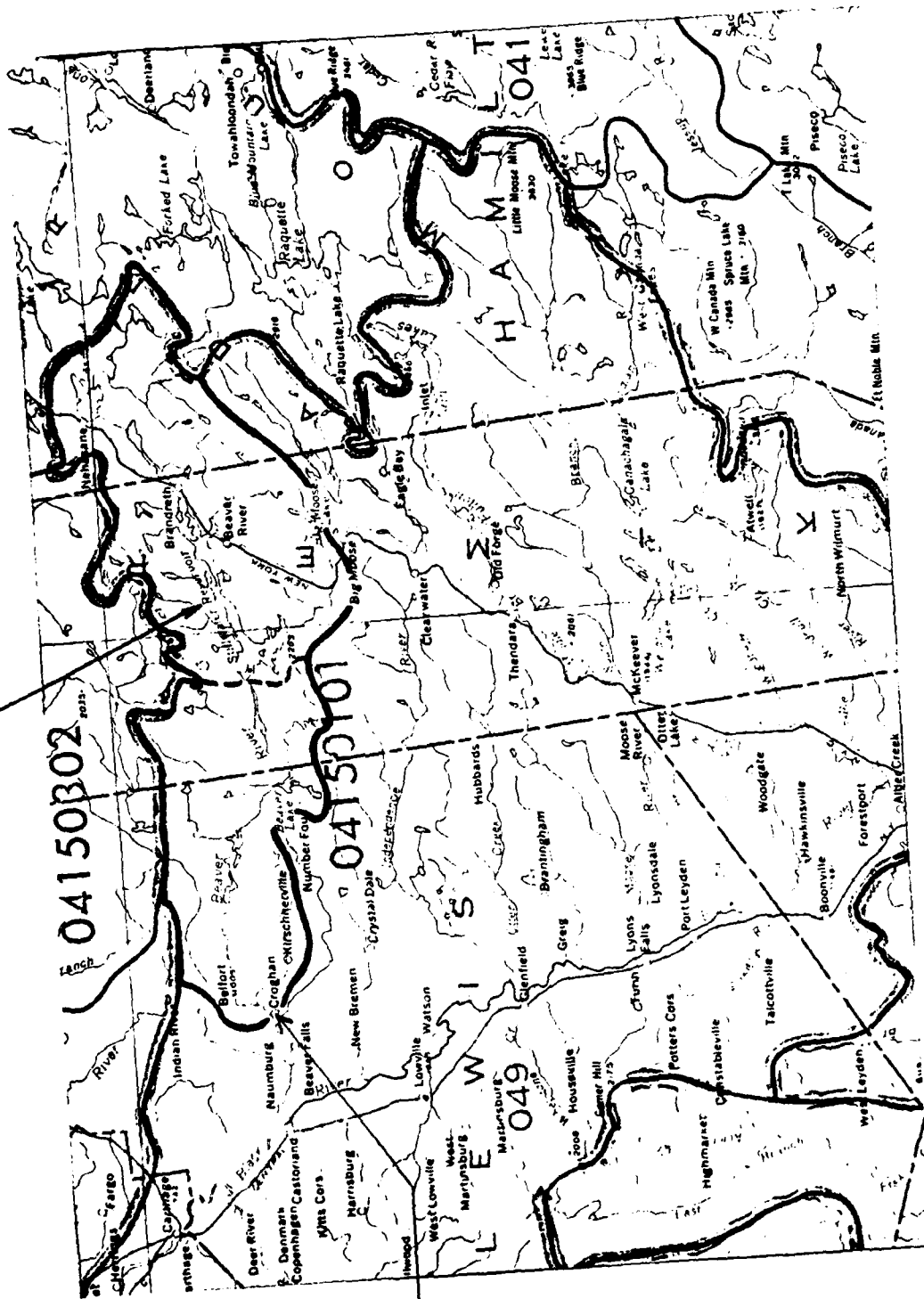
  

		STOPLOG STRUCTURES				WALL @ LEFT SPILLWAY		
		#1	#2	#3	#4			
		(@ RT. SPILLWAY)	( @ LEFT SPILLWAY )					
(SHT 5/)								
BASE FLOW=		10.6	29.1	5	5			
REF. ELEV.	@ H = 0							
	SPILLCREST		$Q = CLH^{3/2}$	$4/$	$C = 3.2$			
	#1 @ 0							
	L →	16'	14'	14'	14'			
ADDITIONAL WEIR FLOW								
	FOR H = 1.0	H = 1.35	H = 1.75	H = 1.05	H = 1.05			
	Q (cfs)	80	103	48	48			
ORIFICE FLOW OCCURS BETWEEN REF. H = 1.0 & H = 3.3		{ NOT INCLUDED						
OVERTOPPING FLOW								
$Q = CLH^{3/2}$								
	C →	2.7	2.7	2.7	2.7	2.7	WALL	
	L →	24'	16'	16'	19'	37'		
	H							
	3.3							
	ΔH	Q	ΔH	Q	ΔH	Q	ΔH	
	3.5	0.2	5	0.2	3	0.2	3	—
	3.6	0.3	10	0.3	7	0.3	7	—
	4	0.7	37	0.7	25	0.7	25	0.4
	4.5	1.2	85	1.2	56	1.2	56	0.9
	4.8	1.5	119	1.5	79	1.5	79	1.2
TOP-OF-DAM = TOP OF CONNECTING CONCRETE WALL								
		L = 306.5'		C = 3.2				

CROGHAN DAM  
NY - 694SUMMARY  
OF  
DISCHARGES

Elev.	H	Stoplog #1	Spillway #1	Log Sluice	Spillway #2	Stoplog #2	Stoplog #3	Spillway #3	Stoplog #4	Wall	TOTAL (cfs)
825.0	0	10	Crest	243	Crest	29	5	----	5	----	292
	0.2	24	13	251	6	43	13	Crest	13		363
	0.5	45	52	275	26	66	26	56	26		572
	1	80	147	334	75	103	48	244	48		1079
	1.5	↑	269	409	137	↑	↑	505	↑		1599
	2		413	498	209			821			2220
	2.5		575	597	289			1184			2924
	3	↓	753	705	377	↓	↓	1587			3701
	3.3	80	866	773	432	103	48	1847			4197
	3.5	85	879	782	439	106	51	2039	↓		4429
	3.6	90	890	790	445	110	55	2132	48	Top	4560
	4	117	953	835	481	128	73	2218	60	25	4890
	4.5	165	1061	913	543	159	104	2424	91	85	5545
	4.8	199	1139	969	587	182	127	2582	115	131	6031

STILLWATER RESERVOIR  
SUBBASIN



DAM  
SITE

## STREAMS TRIBUTARY TO LAKE ONTARIO

## 04150500 STILLWATER RESERVOIR NEAR BEAVER RIVER, NY

LOCATION.--Lat 43°53'50", long 75°03'05", Herkimer County, Hydrologic Unit 04150101, in gatehouse at Stillwater Dam on Beaver River, 2.5 mi (4.0 km) upstream from Moshier Creek, and 7.5 mi (12.1 km) west of Beaver River Post Office.

DRAINAGE AREA.--172 mi<sup>2</sup> (445 km<sup>2</sup>).

PERIOD OF RECORD.--May 1908 to current year. Prior to February 1925, monthend contents only, published in WSP 1507. February 1925 to September 1937, published in WSP 824.

GAGE.--Nonrecording gage read once daily and prior to reservoir gate changes. Datum of gage is National Geodetic Vertical Datum, adjustment of 1912.

REMARKS.--Reservoir originally formed about 1885; enlarged at various times and in 1924 enlarged to a usable capacity of 4,623 mil ft<sup>3</sup> (131 hm<sup>3</sup>) between elevations 1,650.3 ft (503.01 m) and 1,679.3 ft (511.85 m) (top of 24-inch flashboards in place throughout year). Elevation of gate sill of lowest outlet, 1,642.3 ft (500.57 m). Capacity below elevation 1,650.3 ft (503.01 m), 90 mil ft<sup>3</sup> (2.55 hm<sup>3</sup>), is included in records presented herein, but is not ordinarily available for release. Reservoir is used to regulate flow of Beaver and Black Rivers for flood control, power development, and general public welfare.

EXTREMES FOR PERIOD OF RECORD.--Maximum observed elevation, 1,680.08 ft (512.088 m) May 20, 1969, contents, 4,939 mil ft<sup>3</sup> (140 hm<sup>3</sup>); minimum observed since first filling, 1,644.80 ft (501.335 m) Mar. 25-27, 1949, contents, 8 mil ft<sup>3</sup> (0.227 hm<sup>3</sup>).

EXTREMES FOR CURRENT YEAR.--Maximum observed elevation, 1,679.33 ft (511.866 m) May 2, contents, 4,722 mil ft<sup>3</sup> (134 hm<sup>3</sup>); minimum observed, 1,659.69 ft (505.880 m) Mar. 5, contents, 786 mil ft<sup>3</sup> (22.3 hm<sup>3</sup>).

Capacity table, current year (elevation, in feet, and contents, in millions of cubic feet)

1,658.0	604	1,670.0	2,431
1,660.0	821	1,675.0	3,556
1,665.0	1,518	1,680.0	4,916

ELEVATION, IN FEET NGVD, WATER YEAR OCTOBER 1978 TO SEPTEMBER 1979  
INSTANTANEOUS OBSERVATIONS AT 0800

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1666.22	1665.52	1666.16	1666.81	1666.93	1666.90	1671.44	1679.23	1677.63	1674.64	1670.49	1667.36
2	1666.16	1665.43	1666.05	1665.34	1666.84	1666.55	1672.08	1679.33	1677.54	1674.62	1670.34	1667.42
3	1665.95	1665.37	1666.10	1665.97	1666.72	1666.18	1672.83	1679.31	1677.45	1674.54	1670.34	1667.61
4	1665.74	1665.38	1666.19	1666.38	1666.59	1669.43	1673.52	1679.30	1677.35	1674.44	1670.22	1667.67
5	1665.52	1665.44	1666.15	1666.61	1666.50	1669.69	1674.03	1679.30	1677.24	1674.36	1670.05	1667.62
6	1665.38	1665.50	1666.10	1666.66	1666.39	1666.54	1674.43	1679.25	1677.13	1674.26	1669.87	1667.60
7	1665.17	1665.41	1666.04	1667.05	1666.26	1661.61	1674.80	1679.03	1677.02	1674.17	1669.69	1668.26
8	1665.25	1665.31	1663.99	1667.28	1666.14	1662.45	1675.09	1678.78	1676.88	1674.06	1669.49	1668.65
9	1665.33	1665.18	1666.11	1667.31	1666.03	1663.02	1675.23	1678.82	1676.78	1673.96	1669.32	1668.90
10	1665.23	1665.07	1666.40	1667.33	1665.84	1663.44	1675.57	1678.86	1676.66	1673.85	1669.14	1668.98
11	1665.07	1664.95	1666.56	1667.31	1665.64	1663.78	1675.59	1678.84	1676.53	1673.75	1669.01	1668.97
12	1664.87	1665.00	1666.55	1667.29	1665.44	1664.08	1675.59	1678.82	1676.42	1673.65	1668.85	1668.95
13	1664.66	1665.03	1666.52	1667.25	1665.24	1664.32	1675.58	1678.80	1676.36	1673.55	1668.66	1668.90
14	1664.61	1664.90	1666.55	1667.42	1665.81	1664.62	1675.63	1678.80	1676.28	1673.45	1668.46	1668.86
15	1665.08	1664.78	1666.53	1667.67	1664.79	1664.77	1675.80	1678.76	1676.19	1673.33	1668.27	1669.31
16	1665.41	1664.69	1666.46	1667.73	1664.59	1664.88	1675.92	1678.68	1676.11	1673.23	1668.13	1669.65
17	1665.37	1664.57	1666.57	1667.73	1664.34	1664.95	1676.03	1678.63	1676.03	1673.14	1668.00	1669.60
18	1665.29	1664.46	1666.73	1667.70	1664.13	1664.95	1676.18	1678.56	1675.93	1672.96	1667.87	1669.81
19	1665.16	1664.67	1666.67	1667.65	1663.90	1664.91	1676.39	1678.48	1675.85	1672.77	1667.77	1669.89
20	1665.06	1664.83	1666.59	1667.57	1663.67	1664.87	1676.58	1678.39	1675.77	1672.59	1667.67	1669.88
21	1665.02	1664.75	1666.57	1667.55	1663.44	1664.83	1676.79	1678.29	1675.67	1672.40	1667.57	1669.93
22	1665.13	1664.67	1666.55	1667.55	1663.24	1664.87	1677.04	1678.20	1675.57	1672.20	1667.44	1669.99
23	1665.19	1664.55	1666.50	1667.55	1662.89	1665.01	1677.33	1678.11	1675.43	1672.03	1667.31	1670.10
24	1665.09	1664.40	1666.59	1667.51	1662.57	1665.52	1677.65	1678.01	1675.36	1671.83	1667.18	1670.11
25	1665.00	1664.44	1666.76	1667.48	1662.22	1666.87	1677.95	1677.95	1675.26	1671.65	1667.14	1670.05
26	1664.90	1664.50	1666.90	1667.43	1661.94	1668.06	1678.21	1677.87	1675.17	1671.45	1667.24	1669.98
27	1665.01	1664.57	1666.85	1667.36	1661.61	1668.76	1678.42	1677.82	1675.04	1671.33	1667.36	1669.91
28	1665.22	1664.47	1666.78	1667.28	1661.25	1669.23	1678.93	1677.78	1674.95	1671.16	1667.36	1669.83
29	1665.44	1664.38	1666.69	1667.22	---	1669.63	1679.18	1677.73	1674.86	1670.95	1667.34	1669.82
30	1665.59	1664.27	1666.60	1667.14	---	1679.00	1679.11	1677.64	1674.77	1670.78	1667.39	1669.92
31	1665.56	---	1666.67	1667.04	---	1678.52	---	1677.66	---	1670.58	1667.40	---
MEAN	1665.28	1664.89	1666.47	1667.13	1666.85	1666.57	1675.96	1678.55	1676.17	1672.96	1668.46	1669.12
MAX	1666.22	1665.52	1666.90	1667.73	1666.93	1670.52	1679.11	1679.33	1677.63	1674.68	1670.49	1670.11
MIN	1664.61	1664.27	1663.99	1664.81	1661.25	1669.69	1671.44	1677.64	1674.77	1670.50	1667.14	1667.36
?	1605	1392	1480	2035	946	2662	4681	4244	3484	2538	1925	2413
!	-43.3	-82.2	+32.9	+207	-450	+641	+779	-163	-293	-353	-229	+186
CAL YR 1978	MEAN	1669.38	MAX	1678.91	MIN	1658.07	!	-79.1				
UTR YR 1979	MEAN	1669.37	MAX	1679.33	MIN	1659.69	!	+21.9				

? Contents, in millions of cubic feet, at 2400 hours on last day of month by interpolation.  
! Change in contents, equivalent in cubic feet per second.

## STREAMS TRIBUTARY TO LAKE ONTARIO

04258000 BEAVER RIVER AT CROGHAN, NY

LOCATION.--Lat 43°53'50", long 75°24'16", Lewis County, Hydrologic Unit 04150101, on left bank 1,200 ft (366 m) upstream from Black Creek, and 0.5 mi (0.8 km) west of Croghan.

DRAINAGE AREA.--294 mi<sup>2</sup> (761 km<sup>2</sup>).

PERIOD OF RECORD.--September 1930 to current year.

REVISED RECORDS.--WSP 759: Drainage area.

GAGE.--Water-stage recorder. Datum of gage is 806.20 ft (245.730 m) National Geodetic Vertical Datum of 1929.

REMARKS.--Records good. Flow regulated by Stillwater Reservoir (see station 04256500). Between Stillwater Dam and this station, flow is further regulated by several powerplant ponds. Diurnal fluctuation at low and medium flow.

AVERAGE DISCHARGE.--49 years, 593 ft<sup>3</sup>/s (16.79 m<sup>3</sup>/s).

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 5,100 ft<sup>3</sup>/s (144 m<sup>3</sup>/s) May 21, 1969, gage height, 6.98 ft (2.128 m); minimum, 11 ft<sup>3</sup>/s (0.31 m<sup>3</sup>/s) Jan. 22, 29, Feb. 4, 1967, gage height, 0.63 ft (0.192 m); minimum daily, 22 ft<sup>3</sup>/s (0.62 m<sup>3</sup>/s) July 18, 1965.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 2,110 ft<sup>3</sup>/s (59.8 m<sup>3</sup>/s) Apr. 28, gage height, 4.73 ft (1.442 m); minimum, 61 ft<sup>3</sup>/s (1.73 m<sup>3</sup>/s) Jan. 1, gage height, 1.19 ft (0.363 m); minimum daily, 108 ft<sup>3</sup>/s (3.06 m<sup>3</sup>/s) Dec. 25.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1978 TO SEPTEMBER 1979  
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	300	714	480	250	899	772	1010	1380	899	238	500	318
2	286	596	520	906	720	865	955	1320	886	272	684	300
3	341	432	333	1030	552	872	1010	1070	838	303	515	266
4	422	289	369	1200	418	927	992	1130	636	373	475	470
5	480	253	465	1130	558	1310	1210	1100	665	515	391	413
6	510	253	436	1250	1130	1370	1170	1090	690	500	382	579
7	436	607	432	1300	942	1190	1110	1470	765	293	515	596
8	422	613	460	1110	772	999	1040	1540	727	247	624	427
9	446	515	485	636	678	970	955	1160	684	364	552	307
10	505	526	505	845	907	999	906	999	475	352	560	373
11	490	322	531	752	953	984	920	879	785	318	560	423
12	579	293	558	927	1010	920	941	811	702	341	325	329
13	541	293	490	541	721	607	825	408	838	391	360	413
14	505	352	547	391	720	648	778	665	563	344	470	325
15	427	505	531	927	700	955	752	671	422	318	624	504
16	714	404	480	1310	680	913	852	702	451	436	671	746
17	602	289	422	1260	720	852	948	765	356	413	432	575
18	791	373	418	1140	620	785	865	852	505	520	303	476
19	660	341	665	1070	740	831	778	838	422	526	250	485
20	739	377	552	621	740	906	765	811	436	515	400	515
21	772	386	500	708	859	934	708	798	422	445	455	536
22	382	369	510	929	906	948	714	798	404	480	373	340
23	470	360	427	1030	825	906	798	714	247	455	369	256
24	441	455	344	977	759	408	886	798	241	547	413	462
25	337	382	108	941	739	1150	886	733	364	648	303	386
26	275	352	404	899	727	1680	886	714	386	607	250	314
27	526	413	515	927	746	1500	1380	865	373	585	495	408
28	232	422	495	850	798	1090	1990	684	386	432	500	465
29	480	510	495	816	---	1020	1880	879	382	272	440	460
30	590	404	446	906	---	970	1710	920	250	585	541	322
31	739	---	253	899	---	999	---	920	---	590	485	---
TOTAL	15440	12400	14176	28478	21539	30280	30620	28484	16200	13165	14313	12789
MEAN	498	413	457	919	769	977	1021	919	540	425	462	426
MAX	791	714	665	1310	1130	1680	1990	1540	899	648	684	746
MIN	232	253	108	250	418	408	708	408	241	238	250	256
CAL YR 1978	TOTAL	259277	MEAN 710	MAX 2350	MIN 33							
WTR YR 1979	TOTAL	237884	MEAN 652	MAX 1990	MIN 108							

Table 2.--(Continued)

Station number	Station name	Latitude	Longitude	Co. 1/ area code 2/ (mi <sup>2</sup> )	Drainage area (mi <sup>2</sup> )	Date	Discharge (ft <sup>3</sup> /s)
04257950	Balsam Creek near Belfort.....	43 57 08	75 20 24	049	10.1	12- 7 66 12-14-66 5-25-67 8-16-67 8-28-74 6- 6-67 5- 1-68 9- 5-20 10-14-20 11-20-20 1-27-21 5-14-21 7- 9-21 7-10-21 6- 6-67 9- 6-67 5- 1-68 7-15-52 7-17-52 7-22-52 7-29-52 8- 6-52 8-12-52 4-26-55 8-17-55 10- 6-66 12-14-66 5-25-67 6- 6-67 10- 5-67 8-28-74 7-26-67	14.5 *9.77 *8.47 *5.43 *6.6 *5.16 30.3 143 585 362 484 268 423 99 *12.6 *8.91 38.8 2,540 1,610 1,940 1,290 1,360 1,450 7,340 1,670 *99 47.6 *18.4 *1.58 *2.21 *5.53 *1.73
04257960	Murmur Creek near Croghan.....	43 54 32	75 22 15	049	17.8		
	Beaver River near Croghan.....	43 53 34	75 23 58	049			
04258005	Black Creek at Croghan.....	43 53 27	75 23 52	049	22.4		
	Black River at Castorland.....	42 53 39	75 30 18	049	1,626		
04258070	Swiss Creek near Naumburg.....	43 56 13	75 30 28	049	14.7		
04258080	Deer River, East Branch, near Parkers.....	43 42 58	75 41 25	049			
04258082	Deer River tributary, East Branch, near Parkers.....	43 43 01	75 41 14	049			
04258085	Edick Creek at Parkers.....	43 43 56	75 40 18	049			
04258088	Edick Creek at Rector.....	43 44 50	75 41 25	049			
04258090	Mulligan Creek at Parkers.....	43 43 58	75 41 06	049			
04258092	Mulligan Creek at Rector.....	43 44 45	75 41 27	049			
04258095	Edick Creek tributary near Rector.....	43 44 20	75 42 04	049			
04258097	Edick Creek near Rector.....	43 44 15	75 42 25	049			
04258100	Deer River, East Branch, near Liberty Corners.....	43 44 30	75 43 12	049			
04258110	Luther Creek near Parkers.....	43 42 44	75 42 10	049			
04258112	Luther Creek near Hooker.....	43 43 36	75 43 06	049			
04258114	Luther Creek near Liberty Corners.....	43 44 49	75 44 22	049			
04258125	Deer River, West Branch, near Hooker.....	43 42 29	75 44 00	049			

\*\*\*\*\*  
 NEW YORK STATE  
 DEPT OF ENVIRONMENTAL CONSERVATION  
 FLOOD PROTECTION BUREAU

\*\*\*\*\*  
 BLACK RIVER BASIN  
 LEWIS COUNTY  
 CLARK UN

\*\*\*\*\*  
 CROGHAN DAM  
 DEC - 540 BLACK -- BEAVER RIVER  
 SLBBASINS  
 2 0 0 0 0 0 0 0

\*\*\*\*\*  
 J 1 8 1  
 J1 0.05 0.06 0.07 0.08 0.09 0.10 0.50 1  
 K C STINSA 1

\*\*\*\*\*  
 STILLWATER RESV DAM SUBBASIN - DIRECT INPUT CF CLARK UN - INFLOW

\*\*\*\*\*  
 H 1 -1 178 293.1 1  
 P 18.5 69 84 95 101  
 T 1 0.2 0.077

\*\*\*\*\*  
 U1 475 1730 3402 5083 6283 5702 6170 5107 4161 3390  
 U1 2762 2250 1833 1493 1217 991 807 658 536 437  
 U1 356 290 236 192 157 126 104 85 69 56

\*\*\*\*\*  
 X 178 178 1  
 K 1 STIDAM 1

\*\*\*\*\*  
 STILLWATER RESV DAM - ROUTED OUTFLOW

\*\*\*\*\*  
 Y 1 1  
 Y1 1 -1679.3 -1  
 Y1679.3 1681.3 1683.3 1685.3 1687.3 1689.3 1691.3  
 Y5 C 5760 12938 22216 33193 45631 59380  
 \$5 81634 112856 122502 137675 154302 171487 190125 209919  
 \$E 1675 1680 1681.3 1683.3 1685.3 1687.3 1689.3 1691.3

\*\*\*\*\*  
 \$1679.2  
 \$D1687.3 3 1.5 1000

\*\*\*\*\*  
 K 1 RIVER 1

\*\*\*\*\*  
 K1 CHANNEL ROUTING OF HYDROGRAPH TO DAM - BEAVER RIVER

\*\*\*\*\*  
 Y 1 1

\*\*\*\*\*  
 Y1 4

\*\*\*\*\*  
 FLOOD HYDROGRAPH PACKAGE (HFC-1)  
 CAN SAFETY VERSION JULY 1973  
 LAST MODIFICATION 26 FEB 79  
 MODIFIED FOR HONEYWELL APR 79  
 \*\*\*\*\*

\*\*\*\*\*  
 A NY-694

\*\*\*\*\*  
 A  
 A  
 A 96  
 B 5  
 B1 5

\*\*\*\*\*  
 J 1 8 1

\*\*\*\*\*  
 J1 0.05 0.06 0.07 0.08 0.09 0.10 0.50 1

\*\*\*\*\*  
 K C STINSA 1

\*\*\*\*\*  
 K1 STILLWATER RESV DAM SUBBASIN - DIRECT INPUT CF CLARK UN - INFLOW

\*\*\*\*\*  
 H 1 -1 178 293.1 1  
 P 18.5 69 84 95 101  
 T 1 0.2 0.077

\*\*\*\*\*  
 U 3C

\*\*\*\*\*  
 U1 475 1730 3402 5083 6283 5702 6170 5107 4161 3390  
 U1 2762 2250 1833 1493 1217 991 807 658 536 437  
 U1 356 290 236 192 157 126 104 85 69 56

\*\*\*\*\*  
 X 178 178 1  
 K 1 STIDAM 1

\*\*\*\*\*  
 K1 STILLWATER RESV DAM - ROUTED OUTFLOW

\*\*\*\*\*  
 Y 1 1  
 Y1 1 -1679.3 -1  
 Y1679.3 1681.3 1683.3 1685.3 1687.3 1689.3 1691.3  
 Y5 C 5760 12938 22216 33193 45631 59380  
 \$5 81634 112856 122502 137675 154302 171487 190125 209919  
 \$E 1675 1680 1681.3 1683.3 1685.3 1687.3 1689.3 1691.3

\*\*\*\*\*  
 \$1679.2  
 \$D1687.3 3 1.5 1000

\*\*\*\*\*  
 K 1 RIVER 1

\*\*\*\*\*  
 K1 CHANNEL ROUTING OF HYDROGRAPH TO DAM - BEAVER RIVER

\*\*\*\*\*  
 Y 1 1

\*\*\*\*\*  
 Y1 4

32	Y6	0.45	0.45	0.45	825	150	1180.00	0.00037				
33	Y7	100	850	120	840	140	830	190	825	390	825	
34	Y7	440	830	460	840	480	850					
35	K	C	CROBNS									1
36	K1											
37	M	1	0	115.1		293.1						1
38	P		18.5	69	84	95	101					
39	T										1	0.1
40	V	7.4	6.67									
41	X	292	292	1								
42	K	2	CRODAM									1
43	K1											
44	K	1	CRODAM									1
45	K1											
46	Y				1	1						
47	Y1	1							-825	-1		
48	Y4	825	825.2	825.5	826	825.5	827	827.5	828	925.3	828.5	
49	Y4	828.6	829	829.5	829.8							
50	Y5	292	303	572	1079	1599	2220	2924	3701	4197	4429	
51	Y5	4560	4890	5545	6031							
52	\$S	422	797									
53	\$F	825	829.8									
54	\$S	825										
55	\$D	825.2	3.2	1.5	266.5							
56	K	99										
57	A											
58	A											
59	A											
60	A											
61	A											

CROGHAN DAM SUBBASIN - INFLOW HYDROGRAPH

COMBINED HYDROGRAPHS AT DAM

ROUTED OUTFLOW - CROGHAN DAM - SPILLCREST ELEV 825

## PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT STIDSN  
ROUTE HYDROGRAPH T1 STIDAM  
ROUTE HYDROGRAPH T1 RIVER  
RUNOFF HYDROGRAPH AT CRDBSN  
COMBINE 2 HYDROGRAPHS AT CRDDAM  
ROUTE HYDROGRAPH T1 CRDDAM  
END OF NETWORK

NY-054

CRITCHFIELD DAM  
DEC - 340 RI  
SUBBASINS

BLACK -- BEAVER RIVER

BLACK RIVER GASIN  
LEWIS COUNTY  
CLARK UP

NC	PMR	RMN	LDAY	IN	MIN	LB SPECIFICATION
96	2	0	0	0	0	
			JOPER	NWT	LROPT	
			5	0	0	

MULTI-PLAN ANALYSES TO BE PERFORMED

NYT-01879-1  
LIT-87-01879-1

RTICS=	0.05	0.06	0.07	0.08	0.09	0.10	0.50	1.00
APPLN= I	0.05	0.06	0.07	0.08	0.09	0.10	0.50	1.00

\*\*\*\*\*

臺灣省教育廳

得牙醫醫醫牙醫醫

每册定價大洋壹元

● 愛國、愛黨、愛人民、愛和平、愛科學

## SUB-AREA RUNOFF COMPUTATION

STILLWATER	RESV DAM	SURBASIN	- DIRECT	INPLT	CF CLARK	CH -	INFLOW
ISTAQ	ICOMP	IECON	ITYPE	JPLT	JPR1	INAME	ISTAGE
STIBSN	0	0	0	0	0	1	0
							IAUTO
							0

HYDROGRAPH DATA			
IHYDG	IUNG	TAREA	SNAP
1	-1	170.00	0.
			293.10
			0.

**PRECIP DATA**

SPFE	215	R6
0.	18.50	69.00

TRSPC COMPUTED BY THE PROGRAM IS 0.690

LCSS DATA										
LCRPT	STRKR	DLTAR	RTIOL	LRAIN	STRKS	RTIWK	STATL	CNSTL	ALSNX	RTIMP
0	C.	0.	1.00	0.	0.	1.00	1.00	0.20	0.	0.08

GIVEN UNIT GRAPH, NUMQ= 3C								
475.	173C.	3402.	5083.	6283.	617C.	51C7.	4161.	339C.
762.	225C.	1233.	1493.	1217.	991.	653.	536.	437.
356.	29C.	236.	192.	157.	128.	85.	69.	36.

UNIT 6:APH TOTALS 56160. CES OR C.28 INCHES OVER THE AREA

RECESSION DATA  
STRTQ= 172.00 QRCIN= 176.00 RTIOR= 1.00

0  
END-OF-PERIOD FLOW

PERIOD	HR.MN	PERIOD	RAIR	EXCS	LOSS	CHMP	MG.DA	PR.MN	PERIOD	RAIN	EXCS	LOSS	COMP
1	2.00	1	0.02	0.00	0.01	179.	1.05	2.00	45	0.	0.	0.	643.
2	4.00	2	0.02	0.00	0.01	181.	1.05	4.00	50	0.	0.	0.	298.
3	6.00	3	0.02	0.00	0.01	165.	1.05	6.00	51	0.	0.	0.	184.
4	8.00	4	0.05	0.00	0.05	192.	1.05	8.00	52	0.	0.	0.	181.
5	10.00	5	0.05	0.00	0.05	204.	1.05	10.00	53	0.	0.	0.	160.
6	12.00	6	0.05	0.00	0.05	220.	1.05	12.00	54	0.	0.	0.	178.
7	14.00	7	0.19	0.01	0.17	247.	1.05	14.00	55	0.	0.	0.	178.
8	16.00	8	0.36	0.03	0.35	295.	1.05	16.00	56	0.	0.	0.	178.
9	18.00	9	0.15	0.01	0.14	370.	1.05	18.00	57	0.	0.	0.	178.
10	20.00	10	0.02	0.00	0.02	459.	1.05	20.00	58	0.	0.	0.	178.
11	22.00	11	0.02	0.00	0.02	541.	1.05	22.00	59	0.	0.	0.	178.
12	0.	12	0.02	0.00	0.02	594.	1.06	0.	60	0.	0.	0.	178.

SLM 16.63 11.83 4.8C 681563.  
(422)(301)(122)(15299.71)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	68064.	65939.	45644.	16578.	681384.
CMS	1927.	1667.	1293.	586.	19295.
INCHES		3.45	9.54	11.65	11.07
MM		87.53	242.35	295.92	301.49
AC-FT		32697.	90534.	110544.	112625.
7-OLS CU M		40331.	111672.	136334.	138921.

HYDROGRAPH AT STATION FOR PLAN 1, RTIO 1

[illegible]

11.	11.	11.	11.	11.
	PEAK	6-HOUR	24-HOUR	72-HOUR
	4084.	3956.	2739.	1115.
	115.	112.	78.	32.
	CFS	0.21	0.57	0.70
	CMS	5.25	14.54	17.76
	INCHES	1962.	5432.	6633.
	MM	2423.	6700.	8181.
	AC-FT			
	TOTALS CU. M			

12.	13.	14.	15.	16.	17.	18.	19.	20.	21.
3A.	41.	43.	44.	61.	115.	227.	115.	227.	458.
1950.	4203.	4764.	4764.	4549.	3966.	3253.	3966.	3253.	2657.
1770.	1179.	963.	787.	643.	526.	431.	526.	431.	290.
239.	163.	135.	112.	92.	76.	63.	92.	76.	21.
13.	13.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
17.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.

12.	13.	14.	15.	16.	17.	18.	19.	20.	21.
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME			
	4764.	4616.	3195.	1300.	4765.	1351.			
	135.	131.	90.	37.	1351.	0.83			
	CFS	0.24	0.67	0.82	21.10	7884.			
	CMS	6.13	16.56	20.71	7738.	9725.			
	INCHES	2289.	6337.	7738.	5545.				
	MM	2823.	7817.	9545.					
	AC-FT								
	TOTALS CU. M								

14.	15.	16.	17.	18.	19.	20.	21.	22.	23.
43.	47.	49.	51.	70.	136.	259.	30.	37.	1155.
2228.	4804.	5445.	5373.	5199.	4532.	3718.	524.	1155.	2480.
2023.	1347.	1101.	899.	735.	602.	453.	3036.	2480.	332.
273.	186.	154.	123.	105.	87.	72.	404.	332.	24.
15.	14.	14.	14.	14.	14.	14.	51.	24.	14.
14.	14.	14.	14.	14.	14.	14.	14.	14.	14.
14.	14.	14.	14.	14.	14.	14.	14.	14.	14.
14.	14.	14.	14.	14.	14.	14.	14.	14.	14.

14.	15.	16.	17.	18.	19.	20.	21.	22.	23.
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME			
	5445.	5275.	3652.	1486.	5445.	1544.			
	154.	149.	103.	42.	1544.	0.95			
	CFS	0.28	0.76	0.93	23.12	9010.			
	CMS	7.00	19.39	23.67	8844.	11114.			
	INCHES	2616.	7243.	8844.	10908.				
	MM	3227.	8934.	10908.					
	AC-FT								
	TOTALS CU. M								

16.	17.	18.	19.	20.	21.	22.	23.	24.	25.
49.	53.	55.	57.	79.	153.	252.	33.	41.	1304.
2507.	5404.	6126.	6051.	5849.	5095.	4182.	589.	1304.	2790.
2276.	1516.	1238.	1011.	827.	677.	534.	3416.	2790.	373.
307.	209.	173.	144.	119.	98.	81.	455.	373.	27.
17.	16.	16.	16.	16.	16.	16.	58.	27.	16.
16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
16.	16.	16.	16.	16.	16.	16.	16.	16.	16.

16.	17.	18.	19.	20.	21.	22.	23.	24.	25.
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME			

[illegible]

## HYDROGRAPH AT STATION FOR PLAN 1, RTIC '7

64.	96.	52.	96.	102.	110.	124.	148.	185.	230.
270.	292.	296.	307.	316.	439.	848.	1021.	3273.	7245.
3927.	22328.	30023.	34032.	33613.	32496.	28326.	23225.	18977.	15495.
22444.	10317.	421.	6873.	5619.	4593.	3600.	3079.	2526.	2074.
1706.	1405.	1161.	963.	801.	658.	543.	443.	321.	145.
91.	90.	89.	89.	83.	39.	85.	89.	89.	85.
89.	89.	30.	89.	83.	89.	85.	69.	85.	85.
69.	85.	89.	89.	63.	89.	85.	89.	89.	85.
89.	35.	83.	89.	83.	89.	85.	89.	89.	85.
89.	59.	89.	39.	87.	89.	85.	89.	89.	85.

## HYDROGRAPH AT STATION FOR PLAN 1, RTIC 8

172.	185.	192.	204.	220.	247.	286.	370.	459.
541.	592.	613.	632.	877.	1697.	3242.	6546.	1449C.
7855.	60046.	68064.	67235.	66921.	56651.	46469.	37953.	30995.
20634.	16843.	13757.	11231.	9187.	7515.	6159.	5051.	4145.
2811.	2322.	1926.	1602.	1317.	1085.	895.	643.	298.
134.	160.	170.	171.	178.	178.	178.	178.	178.
178.	178.	178.	173.	178.	178.	178.	178.	178.
178.	178.	178.	173.	178.	178.	178.	178.	178.
178.	178.	178.	173.	178.	178.	178.	178.	178.

PEAK	5-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
1	1.0	1.0	1.0	3.0
2	1.0	1.0	1.0	3.0
3	1.0	1.0	1.0	3.0
4	1.0	1.0	1.0	3.0
5	1.0	1.0	1.0	3.0
6	1.0	1.0	1.0	3.0
7	1.0	1.0	1.0	3.0
8	1.0	1.0	1.0	3.0
9	1.0	1.0	1.0	3.0
10	1.0	1.0	1.0	3.0
11	1.0	1.0	1.0	3.0
12	1.0	1.0	1.0	3.0
13	1.0	1.0	1.0	3.0
14	1.0	1.0	1.0	3.0
15	1.0	1.0	1.0	3.0
16	1.0	1.0	1.0	3.0
17	1.0	1.0	1.0	3.0
18	1.0	1.0	1.0	3.0
19	1.0	1.0	1.0	3.0
20	1.0	1.0	1.0	3.0
21	1.0	1.0	1.0	3.0
22	1.0	1.0	1.0	3.0
23	1.0	1.0	1.0	3.0
24	1.0	1.0	1.0	3.0
25	1.0	1.0	1.0	3.0
26	1.0	1.0	1.0	3.0
27	1.0	1.0	1.0	3.0
28	1.0	1.0	1.0	3.0
29	1.0	1.0	1.0	3.0
30	1.0	1.0	1.0	3.0
31	1.0	1.0	1.0	3.0
32	1.0	1.0	1.0	3.0
33	1.0	1.0	1.0	3.0
34	1.0	1.0	1.0	3.0
35	1.0	1.0	1.0	3.0
36	1.0	1.0	1.0	3.0
37	1.0	1.0	1.0	3.0
38	1.0	1.0	1.0	3.0
39	1.0	1.0	1.0	3.0
40	1.0	1.0	1.0	3.0
41	1.0	1.0	1.0	3.0
42	1.0	1.0	1.0	3.0
43	1.0	1.0	1.0	3.0
44	1.0	1.0	1.0	3.0
45	1.0	1.0	1.0	3.0
46	1.0	1.0	1.0	3.0
47	1.0	1.0	1.0	3.0
48	1.0	1.0	1.0	3.0
49	1.0	1.0	1.0	3.0
50	1.0	1.0	1.0	3.0
51	1.0	1.0	1.0	3.0
52	1.0	1.0	1.0	3.0
53	1.0	1.0	1.0	3.0
54	1.0	1.0	1.0	3.0
55	1.0	1.0	1.0	3.0
56	1.0	1.0	1.0	3.0
57	1.0	1.0	1.0	3.0
58	1.0	1.0	1.0	3.0
59	1.0	1.0	1.0	3.0
60	1.0	1.0	1.0	3.0
61	1.0	1.0	1.0	3.0
62	1.0	1.0	1.0	3.0
63	1.0	1.0	1.0	3.0
64	1.0	1.0	1.0	3.0
65	1.0	1.0	1.0	3.0
66	1.0	1.0	1.0	3.0
67	1.0	1.0	1.0	3.0
68	1.0	1.0	1.0	3.0
69	1.0	1.0	1.0	3.0
70	1.0	1.0	1.0	3.0
71	1.0	1.0	1.0	3.0
72	1.0	1.0	1.0	3.0
73	1.0	1.0	1.0	3.0
74	1.0	1.0	1.0	3.0
75	1.0	1.0	1.0	3.0
76	1.0	1.0	1.0	3.0
77	1.0	1.0	1.0	3.0
78	1.0	1.0	1.0	3.0
79	1.0	1.0	1.0	3.0
80				

	PEAK	5-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	60064.	5939.	45644.	18578.	601384.
CMS	1927.	1867.	1293.	536.	15295.
JONES		3.45	9.54	11.65	11.87
MM		87.53	242.35	295.92	301.49
ACFT		32697.	90534.	110544.	112625.
FT-CUS CU M		40331.	111672.	136354.	138921.

NO  
C-FT  
TUS CUM

87.33 242.35 295.82 301.49  
326.07 90534. 110544. 112825.  
40331. 111672. 136354. 136921.

\*\*\*\*\*

\*\*\*\*\*

\*\*\*\*\*

\*\*\*\*\*

# HYDROGRAPH ROUTING

STILLWATER RESV DAM - ROUTED OUTFLOW  
ISTAQ ICDAP IFCON ITAPE JPLT JPRY IRAME ISTAGE IAUTO  
STIDAM 1 0 0 0 0 C 1 0 0

ROUTING DATA  
QLOSS CLOSS AVG IRES ISAME IDPT IPMP LSTR  
0. 0. 0. 1 1 0 0 0 0

RSTPS NSTDL LAG AMSKK X TSK STCRS ISPRAT  
1 0 0 0. 0. C. -1679. -1

STAGE 1679.30 1683.30 1685.30 1687.30 1689.30 1691.30  
FLUM 0. 5760.00 12936.00 22216.00 33193.00 45631.00 59380.00  
CAPACITY= 81634. 112856. 122502. 137675. 154002. 171487. 190125. 209919.  
ELEVATION= 1675. 1680. 1681. 1683. 1685. 1687. 1689. 1691.

CREL SPWID COOW EXPW ELEV CCCL CAREA EXPL  
1679.3 0. 0. 0. 0. C. 0. 0.

DAM DATA  
TCPEL COOD EXPD DAMAD  
1687.3 3.0 1.5 1000.

STATION STIDAM, PLAN 1, RATIC 1  
END-OF-PERIOD HYDROGRAPH COORDINATES

OUTFLOW		STORAGE	
1.	2.	1.	2.
10. 271.	11. 443.	108489.	108490.
136. 1350.	120. 1320.	108509.	108512.
899. 845.	793. 743.	109445.	109446.
456. 423.	393. 365.	111413.	111414.
219. 203.	189. 176.	110203.	110204.
107. 100.	95. 87.	109337.	109338.
55. 51.	48. 45.	108694.	108697.
30. 29.	27. 26.	108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.
		108596.	108599.
		108547.	108549.
		108489.	108490.
		108512.	108515.
		109445.	109446.
		111413.	111414.
		110203.	110204.
		109337.	109338.
		108694.	108697.
		108701.	108704.

PEAK CURRENT IS 1917. AT THE 62.00 HOURS

CFS  
CYS  
INCHES  
MM  
AC-FT  
T-GLS CU M

STATION SYDNEY, PLAN 1, RATIC 4  
END-OF-PERIOD HYDROGRAPH ORIGINATES

OUTFLOW									
1.	2.	3.	4.	5.	6.	7.	8.	9.	11.
13.	15.	10.	20.	22.	25.	31.	43.	66.	125.
40.	434.	710.	1034.	1355.	1644.	1881.	2041.	2124.	2164.
69.	2148.	2108.	2053.	1983.	1899.	1811.	1720.	1626.	1532.
36.	1302.	1278.	1190.	1121.	1048.	975.	914.	852.	793.
34.	634.	635.	590.	541.	509.	473.	439.	408.	375.
53.	328.	305.	284.	264.	246.	229.	213.	198.	185.
73.	161.	156.	140.	131.	123.	115.	107.	101.	94.
83.	33.	74.	73.	69.	65.	61.	58.	55.	52.
49.	46.	44.	42.	40.	38.				

108491.	108493.	108497.	108499.	108502.
108523.	108523.	108539.	108551.	108556.
108426.	110224.	112050.	112563.	113236.
113197.	112951.	112603.	112512.	111819.
1113250.	112785.	110758.	110606.	110204.
111111625.	111437.	110958.	110510.	109332.
11110001.	109764.	109673.	109548.	109370.
109146.	109100.	109051.	109018.	108916.
108735.	108735.	108769.	108751.	108687.
108654.	108644.	108626.	108618.	108689.
108580.	108576.	108571.	108567.	108597.

[illegible]

PEAK OUTFLOW IS 2169. AT TIME 62.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
CFS	2169.	2156.	2003.	1323.		54335.
CMS	61.	61.	57.	37.		1539.
INCHES		0.11	0.42	0.83		0.95
MM		2.86	10.65	21.07		24.04
AC-FT		1069.	3977.	7876.		8981.
T+DLS CU M		1319.	4906.	9708.		11070.

STATION: STIDAM, PLAN 1, RATIC 5



PEAK OUTFLOW IS 30003. AT TIME 60.00 HOURS

PLAN		6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13559.	13441.	12326.	8079.	33726.
CMS	384.	381.	349.	229.	958.
IPCHES	0.70	2.58	5.07	5.88	
MM	17.84	65.45	128.69	149.35	
AC-ET	6665.	24448.	48072.	55781.	
T-OLDS CU M	8221.	30156.	59296.	68617.	

STATION: SYDAM, PLAN 1, RATIO 2  
END-OF-PERIOD HYDROGRAPH COORDINATES

OUTFLOW		70.	82.	55.	113.	135.
59.	275.	311.	382.	524.	855.	1364.
17379.	21751.	25259.	28124.	29514.	29514.	30003.
25437.	23935.	22399.	20986.	19606.	19606.	18260.
12463.	11640.	10855.	10112.	9409.	9409.	6737.
5970.	5573.	5238.	4924.	4629.	4629.	4352.
3207.	3018.	2842.	2675.	2521.	2521.	2375.
1731.	1619.	1515.	1419.	1329.	1329.	1245.
910.	857.	808.	762.	719.	719.	660.
522.	497.					
STORAGE		108637.	106663.	108653.	108730.	108778.
108613.	109063.	109158.	109312.	109644.	110338.	111877.
109023.	145490.	153184.	159327.	163413.	165626.	166405.
161338.	159133.	156740.	154292.	151837.	149409.	147040.
138531.	136683.	134932.	132711.	131762.	130216.	128754.
122945.	122021.	121158.	120348.	119588.	118876.	118176.
115924.	115439.	114964.	114557.	114157.	113782.	113385.
112237.	111995.	111770.	111560.	111366.	111185.	110959.
110450.	110343.	110236.	110137.	110045.	109959.	109878.
109675.	109562.					
STAGE		1679.3	1679.3	1679.3	1679.3	1679.3
1679.4	1679.4	1679.4	1679.4	1679.5	1679.6	1679.8
1684.3	1685.2	1685.5	1686.4	1686.7	1686.7	1686.7
1685.9	1685.6	1685.3	1685.0	1684.7	1684.4	1684.4
1693.2	1692.9	1692.7	1692.5	1692.3	1692.1	1692.1
1681.4	1681.2	1681.1	1681.0	1680.9	1680.8	1680.8
1690.4	1690.3	1690.3	1690.2	1690.2	1690.1	1690.1
1679.9	1679.9	1679.8	1679.8	1679.8	1679.7	1679.7
1679.6	1679.6	1679.6	1679.6	1679.6	1679.5	1679.5
1679.5	1679.5	1679.5	1679.5	1679.5	1679.5	1679.5

PEAK OUTFLOW IS 30003. AT TIME 60.00 HOURS

PEAK		6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	30003.	29717.	26639.	16452.	675260.
CMS	850.	841.	756.	466.	19121.
INCHES	1.55	1.55	5.58	10.32	11.76
MM	39.45	141.71	262.07	298.78	111613.
AC-FT	14736.	52937.	97897.	137673.	
TOTALS CU M	18176.	65297.	120755.		

\*\*\*\*\*

	PEAK	6-11" UP	24-36" UP	72-84" UP	TOTAL VOLUME
CFS	30003.	29717.	26639.	16452.	675260.
CMS	850.	841.	756.	466.	19121.
INCHES		1.55	5.53	10.32	11.76
MM		39.45	141.71	262.67	290.78
AC-FT		16735.	52937.	97897.	111613.
T-DISC CU M		10176.	65297.	120755.	137673.

一、**總論**  
 二、**經濟學概論**  
 三、**經濟學之發展**  
 四、**經濟學之分類**  
 五、**經濟學之方法**  
 六、**經濟學之範圍**  
 七、**經濟學之重要性**  
 八、**經濟學之未來**  
 九、**經濟學之結論**  
 十、**經濟學之附錄**  
 十一、**經濟學之參考文獻**  
 十二、**經濟學之索引**  
 十三、**經濟學之圖表**  
 十四、**經濟學之公式**  
 十五、**經濟學之定義**  
 十六、**經濟學之術語**  
 十七、**經濟學之歷史**  
 十八、**經濟學之理論**  
 十九、**經濟學之實踐**  
 二十、**經濟學之政策**  
 二十一、**經濟學之批判**  
 二十二、**經濟學之展望**  
 二十三、**經濟學之總結**  
 二十四、**經濟學之附錄**  
 二十五、**經濟學之參考文獻**  
 二十六、**經濟學之索引**  
 二十七、**經濟學之圖表**  
 二十八、**經濟學之公式**  
 二十九、**經濟學之定義**  
 三十、**經濟學之術語**  
 三十一、**經濟學之歷史**  
 三十二、**經濟學之理論**  
 三十三、**經濟學之實踐**  
 三十四、**經濟學之政策**  
 三十五、**經濟學之批判**  
 三十六、**經濟學之展望**  
 三十七、**經濟學之總結**  
 三十八、**經濟學之附錄**  
 三十九、**經濟學之參考文獻**  
 四十、**經濟學之索引**  
 四十一、**經濟學之圖表**  
 四十二、**經濟學之公式**  
 四十三、**經濟學之定義**  
 四十四、**經濟學之術語**  
 四十五、**經濟學之歷史**  
 四十六、**經濟學之理論**  
 四十七、**經濟學之實踐**  
 四十八、**經濟學之政策**  
 四十九、**經濟學之批判**  
 五十、**經濟學之展望**  
 五十一、**經濟學之總結**  
 五十二、**經濟學之附錄**  
 五十三、**經濟學之參考文獻**  
 五十四、**經濟學之索引**  
 五十五、**經濟學之圖表**  
 五十六、**經濟學之公式**  
 五十七、**經濟學之定義**  
 五十八、**經濟學之術語**  
 五十九、**經濟學之歷史**  
 六十、**經濟學之理論**  
 六十一、**經濟學之實踐**  
 六十二、**經濟學之政策**  
 六十三、**經濟學之批判**  
 六十四、**經濟學之展望**  
 六十五、**經濟學之總結**  
 六十六、**經濟學之附錄**  
 六十七、**經濟學之參考文獻**  
 六十八、**經濟學之索引**  
 六十九、**經濟學之圖表**  
 七十、**經濟學之公式**  
 七十一、**經濟學之定義**  
 七十二、**經濟學之術語**  
 七十三、**經濟學之歷史**  
 七十四、**經濟學之理論**  
 七十五、**經濟學之實踐**  
 七十六、**經濟學之政策**  
 七十七、**經濟學之批判**  
 七十八、**經濟學之展望**  
 七十九、**經濟學之總結**  
 八十、**經濟學之附錄**  
 八十一、**經濟學之參考文獻**  
 八十二、**經濟學之索引**  
 八十三、**經濟學之圖表**  
 八十四、**經濟學之公式**  
 八十五、**經濟學之定義**  
 八十六、**經濟學之術語**  
 八十七、**經濟學之歷史**  
 八十八、**經濟學之理論**  
 八十九、**經濟學之實踐**  
 九十、**經濟學之政策**  
 九十一、**經濟學之批判**  
 九十二、**經濟學之展望**  
 九十三、**經濟學之總結**  
 九十四、**經濟學之附錄**  
 九十五、**經濟學之參考文獻**  
 九十六、**經濟學之索引**  
 九十七、**經濟學之圖表**  
 九十八、**經濟學之公式**  
 九十九、**經濟學之定義**  
 一百、**經濟學之術語**  
 一百零一、**經濟學之歷史**  
 一百零二、**經濟學之理論**  
 一百零三、**經濟學之實踐**  
 一百零四、**經濟學之政策**  
 一百零五、**經濟學之批判**  
 一百零六、**經濟學之展望**  
 一百零七、**經濟學之總結**  
 一百零八、**經濟學之附錄**  
 一百零九、**經濟學之參考文獻**  
 一百一十、**經濟學之索引**  
 一百一十一、**經濟學之圖表**  
 一百一十二、**經濟學之公式**  
 一百一十三、**經濟學之定義**  
 一百一十四、**經濟學之術語**  
 一百一十五、**經濟學之歷史**  
 一百一十六、**經濟學之理論**  
 一百一十七、**經濟學之實踐**  
 一百一十八、**經濟學之政策**  
 一百一十九、**經濟學之批判**  
 一百二十、**經濟學之展望**  
 一百二十一、**經濟學之總結**  
 一百二十二、**經濟學之附錄**  
 一百二十三、**經濟學之參考文獻**  
 一百二十四、**經濟學之索引**  
 一百二十五、**經濟學之圖表**  
 一百二十六、**經濟學之公式**  
 一百二十七、**經濟學之定義**  
 一百二十八、**經濟學之術語**  
 一百二十九、**經濟學之歷史**  
 一百三十、**經濟學之理論**  
 一百三十一、**經濟學之實踐**  
 一百三十二、**經濟學之政策**  
 一百三十三、**經濟學之批判**  
 一百三十四、**經濟學之展望**  
 一百三十五、**經濟學之總結**  
 一百三十六、**經濟學之附錄**  
 一百三十七、**經濟學之參考文獻**  
 一百三十八、**經濟學之索引**  
 一百三十九、**經濟學之圖表**  
 一百四十、**經濟學之公式**  
 一百四十一、**經濟學之定義**  
 一百四十二、**經濟學之術語**  
 一百四十三、**經濟學之歷史**  
 一百四十四、**經濟學之理論**  
 一百四十五、**經濟學之實踐**  
 一百四十六、**經濟學之政策**  
 一百四十七、**經濟學之批判**  
 一百四十八、**經濟學之展望**  
 一百四十九、**經濟學之總結**  
 一百五十、**經濟學之附錄**  
 一百五十一、**經濟學之參考文獻**  
 一百五十二、**經濟學之索引**  
 一百五十三、**經濟學之圖表**  
 一百五十四、**經濟學之公式**  
 一百五十五、**經濟學之定義**  
 一百五十六、**經濟學之術語**  
 一百五十七、**經濟學之歷史**  
 一百五十八、**經濟學之理論**  
 一百五十九、**經濟學之實踐**  
 一百六十、**經濟學之政策**  
 一百六十一、**經濟學之批判**  
 一百六十二、**經濟學之展望**  
 一百六十三、**經濟學之總結**  
 一百六十四、**經濟學之附錄**  
 一百六十五、**經濟學之參考文獻**  
 一百六十六、**經濟學之索引**  
 一百六十七、**經濟學之圖表**  
 一百六十八、**經濟學之公式**  
 一百六十九、**經濟學之定義**  
 一百七十、**經濟學之術語**  
 一百七十一、**經濟學之歷史**  
 一百七十二、**經濟學之理論**  
 一百七十三、**經濟學之實踐**  
 一百七十四、**經濟學之政策**  
 一百七十五、**經濟學之批判**  
 一百七十六、**經濟學之展望**  
 一百七十七、**經濟學之總結**  
 一百七十八、**經濟學之附錄**  
 一百七十九、**經濟學之參考文獻**  
 一百八十、**經濟學之索引**  
 一百八十一、**經濟學之圖表**  
 一百八十二、**經濟學之公式**  
 一百八十三、**經濟學之定義**  
 一百八十四、**經濟學之術語**  
 一百八十五、**經濟學之歷史**  
 一百八十六、**經濟學之理論**  
 一百八十七、**經濟學之實踐**  
 一百八十八、**經濟學之政策**  
 一百八十九、**經濟學之批判**  
 一百九十、**經濟學之展望**  
 一百九十一、**經濟學之總結**  
 一百九十二、**經濟學之附錄**  
 一百九十三、**經濟學之參考文獻**  
 一百九十四、**經濟學之索引**  
 一百九十五、**經濟學之圖表**  
 一百九十六、**經濟學之公式**  
 一百九十七、**經濟學之定義**  
 一百九十八、**經濟學之術語**  
 一百九十九、**經濟學之歷史**  
 二百、**經濟學之理論**  
 二百零一、**經濟學之實踐**  
 二百零二、**經濟學之政策**  
 二百零三、**經濟學之批判**  
 二百零四、**經濟學之展望**  
 二百零五、**經濟學之總結**  
 二百零六、**經濟學之附錄**  
 二百零七、**經濟學之參考文獻**  
 二百零八、**經濟學之索引**  
 二百零九、**經濟學之圖表**  
 二百一十、**經濟學之公式**  
 二百一十一、**經濟學之定義**  
 二百一十二、**經濟學之術語**  
 二百一十三、**經濟學之歷史**  
 二百一十四、**經濟學之理論**  
 二百一十五、**經濟學之實踐**  
 二百一十六、**經濟學之政策**  
 二百一十七、**經濟學之批判**  
 二百一十八、**經濟學之展望**  
 二百一十九、**經濟學之總結**  
 二百二十、**經濟學之附錄**

CHANNEL ROUTING OF HYDROGRAPH TC DA:1 - BEAVER RIVER									
ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO	
RIVER	1	0	0	0	0		1	0	0

QCLASS	CROSS	AVG	ROUTING DATA						IPMP	LSTR
0.	0.	0.	IRES	ISAME	IOPT					
			1	1	0				0	
NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRA			
4	0	0	0.	0.	0.	0.	0.	0	0	

NOTIONAL DEPTH CHANNEL ROLLING

QIN(1)	QIN(2)	QIN(3)	ELAVT	ELMAX	RLNTH	SEL
0.0450	0.0450	0.0450	825.0	850.0	118600.	0.00687

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

DATE	DESCRIPTION	AMOUNT	BALANCE
10/1/00	OPENING BALANCE	100.00	100.00
10/2/00	PAYROLL	25.00	75.00
10/3/00	RENT	15.00	60.00
10/4/00	SALES	30.00	90.00
10/5/00	EXPENSES	10.00	80.00
10/6/00	SALES	20.00	100.00
10/7/00	PAYROLL	25.00	75.00
10/8/00	RENT	15.00	60.00
10/9/00	SALES	30.00	90.00
10/10/00	EXPENSES	10.00	80.00
10/11/00	SALES	20.00	100.00
10/12/00	PAYROLL	25.00	75.00
10/13/00	RENT	15.00	60.00
10/14/00	SALES	30.00	90.00
10/15/00	EXPENSES	10.00	80.00
10/16/00	SALES	20.00	100.00
10/17/00	PAYROLL	25.00	75.00
10/18/00	RENT	15.00	60.00
10/19/00	SALES	30.00	90.00
10/20/00	EXPENSES	10.00	80.00
10/21/00	SALES	20.00	100.00
10/22/00	PAYROLL	25.00	75.00
10/23/00	RENT	15.00	60.00
10/24/00	SALES	30.00	90.00
10/25/00	EXPENSES	10.00	80.00
10/26/00	SALES	20.00	100.00
10/27/00	PAYROLL	25.00	75.00
10/28/00	RENT	15.00	60.00
10/29/00	SALES	30.00	90.00
10/30/00	EXPENSES	10.00	80.00
10/31/00	SALES	20.00	100.00
11/1/00	PAYROLL	25.00	75.00
11/2/00	RENT	15.00	60.00
11/3/00	SALES	30.00	90.00
11/4/00	EXPENSES	10.00	80.00
11/5/00	SALES	20.00	100.00
11/6/00	PAYROLL	25.00	75.00
11/7/00	RENT	15.00	60.00
11/8/00	SALES	30.00	90.00
11/9/00	EXPENSES	10.00	80.00
11/10/00	SALES	20.00	100.00
11/11/00	PAYROLL	25.00	75.00
11/12/00	RENT	15.00	60.00
11/13/00	SALES	30.00	90.00
11/14/00	EXPENSES	10.00	80.00
11/15/00	SALES	20.00	100.00
11/16/00	PAYROLL	25.00	75.00
11/17/00	RENT	15.00	60.00
11/18/00	SALES	30.00	90.00
11/19/00	EXPENSES	10.00	80.00
11/20/00	SALES	20.00	100.00
11/21/00	PAYROLL	25.00	75.00
11/22/00	RENT	15.00	60.00
11/23/00	SALES	30.00	90.00
11/24/00	EXPENSES	10.00	80.00
11/25/00	SALES	20.00	100.00
11/26/00	PAYROLL	25.00	75.00
11/27/00	RENT	15.00	60.00
11/28/00	SALES	30.00	90.00
11/29/00	EXPENSES	10.00	80.00
11/30/00	SALES	20.00	100.00
12/1/00	PAYROLL	25.00	75.00
12/2/00	RENT	15.00	60.00
12/3/00	SALES	30.00	90.00
12/4/00	EXPENSES	10.00	80.00
12/5/00	SALES	20.00	100.00
12/6/00	PAYROLL	25.00	75.00
12/7/00	RENT	15.00	60.00
12/8/00	SALES	30.00	90.00
12/9/00	EXPENSES	10.00	80.00
12/10/00	SALES	20.00	100.00
12/11/00	PAYROLL	25.00	75.00
12/12/00	RENT	15.00	60.00
12/13/00	SALES	30.00	90.00
12/14/00	EXPENSES	10.00	80.00
12/15/00	SALES	20.00	100.00
12/16/00	PAYROLL	25.00	75.00
12/17/00	RENT	15.00	60.00
12/18/00	SALES	30.00	90.00
12			

STORAGE	0.	763.63	1621.54	2573.72	3618.67	4706.61	5813.41	6939.06	8083.56	9246.93
	10429.14	11630.21	12850.14	14086.92	15346.55	16623.05	17918.39	19232.59	20565.65	21917.56
OUTFLOW	0.	587.74	2093.20	5847.51	9326.67	15169.22	21429.83	28566.10	36546.26	45346.24
	54946.53	65332.26	76490.80	88412.21	101088.28	114512.29	128678.74	143583.15	159221.92	175592.17
STAGE	825.00	826.32	827.63	828.95	830.26	831.58	832.89	834.21	835.53	836.84
	838.16	839.47	840.79	842.11	843.42	844.74	846.05	847.37	848.68	850.00
FLOW	0.	887.74	2893.20	5847.51	9326.67	15169.22	21429.83	28566.10	36546.26	45346.24
	54946.53	65332.26	76490.80	88412.21	101088.28	114512.29	128678.74	143583.15	159221.92	175592.17

STATION RIVER, PLAN 1, RTIC 1

[illegible]

## STATION RIVER, PLAN 1, RTIC 4

	0.	1.	2.	3.	4.	5.
0.	0.	1.	2.	3.	4.	5.
1.	1.	10.	13.	14.	21.	25.
2.	7.	14.	42.	108.	1623.	1881.
3.	52.	87.	207.	1941.	1659.	1772.
4.	2107.	2142.	1847.	1054.	1023.	957.
5.	2027.	1502.	739.	650.	606.	565.
6.	1082.	421.	368.	316.	294.	273.
7.	877.	422.	179.	155.	145.	135.
8.	473.	454.	85.	80.	75.	71.
9.	526.	554.	50.			
10.	254.	237.				
11.	127.	111.				
12.	67.	59.				

[illegible][illegible]

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
CFS	2142.	2132.	1978.	1363.		54100.
CMS	61.	60.	56.	37.		1532.
INCHES		0.11	0.41	0.82		0.94
MM		2.83	10.50	20.75		23.94
AC-FT		1057.	3922.	7753.		8942.
T-DLS CU M		1304.	4938.	9563.		11030.

MAXIMUM STORAGE = 325.

827.1

## MAXIMUM STAGE IS

## STATION RIVER, PLAN 1, RTIG 5

OUTFLOW	
0.	1.
0.	11.
6.	167.
55.	2380.
2239.	2377.
1802.	1701.
1052.	396.
1009.	872.
594.	479.
553.	515.
0.	0.
6.	9.
39.	97.
2252.	2377.
1802.	1701.
1052.	396.
1009.	872.
594.	479.
553.	515.
0.	0.
6.	9.
39.	97.
2252.	2377.
1802.	1701.
1052.	396.
1009.	872.
594.	479.
553.	515.
0.	0.
6.	9.
39.	97.
2252.	2377.
1802.	1701.
1052.	396.
1009.	872.
594.	479.
553.	515.
0.	0.
6.	9.
39.	97.
2252.	2377.
1802.	1701.
1052.	396.
1009.	872.
594.	479.
553.	515.
0.	0.
6.	9.
39.	97.
2252.	2377.
1802.	1701.
1052.	396.
1009.	872.
594.	479.
553.	515.
0.	0.
6.	9.
39.	97.
2252.	2377.
1802.	1701.
1052.	396.
1009.	872.
594.	479.
553.	515.
0.	0.
6.	9.
39.	97.
2252.	2377.
1802.	1701.
1052.	396.
1009.	872.
594.	479.
553.	515.
0.	0.
6.	9.
39.	97.
2252.	2377.
1802.	1701.
1052.	396.
1009.	872.
594.	479.
553.	515.
0.	0.
6.	9.
39.	97.
2252.	2377.
1802.	1701.
1052.	396.
1009.	872.
594.	479.
553.	515.
0.	0.
6.	9.
39.	97.
2252.	2377.
1802.	1701.
1052.	396.
1009.	872.
594.	479.
553.	515.
0.	0.
6.	9.
39.	97.
2252.	2377.
1802.	1701.
1052.	396.
1009.	872.
594.	479.
553.	515.
0.	0.
6.	9.
39.	97.
2252.	2377.
1802.	1701.
1052.	396.
1009.	872.
594.	479.
553.	515.
0.	0.
6.	9.
39.	97.
2252.	2377.
1802.	1701.
1052.	396.
1009.	872.
594.	479.
553.	515.
0.	0.
6.	9.
39.	97.
2252.	2377.
1802.	1701.
1052.	396.
1009.	872.
594.	479.
553.	515.
0.	0.
6.	9.
39.	97.
2252.	2377.
1802.	1701.
1052.	396.
1009.	872.
594.	479.
553.	515.
0.	0.
6.	9.
39.	97.
2252.	2377.
1802.	1701.
1052.	396.
1009.	872.
594.	479.
553.	515.
0.	0.
6.	9.
39.	97.
2252.	2377.
1802.	1701.
1052.	396.
1009.	872.
594.	479.
553.	515.
0.	0.
6.	9.
39.	97.</

MAXIMUM STAFF IS 827.5

MAXIMUM STORAGE ■	376.
-------------------	------

STATION KIVER, PLAN 1, RTIC 7

[illegible]

**STOR**

[illegible]

## STAGE

[illegible]

TOTAL VOLUME

	PEAK	6-HOUR	24-HOUR	72-HOUR
CFS	13528.	13391.	12278.	8033.
CMS	353.	379.	348.	227.
1:1C-MES		0.70	2.57	5.04
MM		17.77	65.19	127.96
AC-FT		6640.	24353.	47802.
TOTALS CU M		8190.	30039.	58962.

MAXIMUM STORAGE • 1093.

MAXIMUM STAGE IS 831.2

STATION RIVER, PLAN 1, RTIC 8

	1.	3.	7.	12.	19.	28.	37.	47.	58.
71.	127.	127.	127.	141.	155.	191.	220.	258.	318.
49.	535.	535.	535.	1037.	1653.	2157.	2554.	2811.	2955.
997.	2811.	2811.	2811.	2679.	2533.	2386.	2235.	2092.	1971.
997.	1725.	1725.	1725.	1771.	1770.	1728.	1621.	1529.	1467.

I CIES 312. 277. 5012.  
 0.0 2.57 5.05  
 17.77 65.19 127.56  
 6640. 24353. 47802.  
 8190. 30039. 58962.  
 68484.

AC-FT

T+OLS CU M

MAXIMUM STORAGE = 1093.

MAXIMUM STAGE IS 831.2

STATION RIVER, PLAN 1, RTIC 8

0.	1.	3.	7.	12.	19.	28.	37.	47.	58.
71.	85.	101.	120.	141.	165.	191.	220.	258.	318.
442.	556.	2482.	5535.	10537.	16536.	21574.	25544.	28110.	29557.
29977.	29713.	29006.	28011.	26797.	25363.	23863.	22350.	20992.	19717.
18365.	17054.	15818.	14725.	13713.	12708.	11825.	11041.	10294.	9667.
9119.	8437.	7861.	7283.	6749.	6260.	5849.	5546.	5230.	4918.
4623.	4347.	4083.	3843.	3617.	3403.	3203.	3019.	2869.	2750.
2610.	2465.	2325.	2190.	2060.	1932.	1808.	1691.	1582.	1480.
1386.	1295.	1213.	1142.	1072.	1008.	945.	894.	879.	859.
832.	765.	705.	657.	612.	572.	537.	504.	479.	454.

STOR

0.	1.	3.	4.	6.	8.	10.	13.
15.	22.	30.	36.	41.	47.	55.	68.
96.	361.	941.	1237.	1459.	1616.	1717.	1770.
1785.	1751.	1665.	1608.	1545.	1490.	1434.	1378.
1318.	1260.	1154.	1051.	966.	907.	854.	804.
859.	817.	776.	738.	703.	671.	644.	619.
545.	523.	502.	482.	464.	446.	430.	416.
375.	360.	345.	330.	316.	303.	289.	277.
244.	235.	226.	218.	211.	204.	197.	189.
179.	172.	164.	157.	149.	141.	133.	125.

STAGE

825.0	825.0	825.0	825.0	825.0	825.0	825.0	825.0	825.0	825.0
825.0	825.0	825.0	825.0	825.0	825.0	825.0	825.0	825.0	825.0
825.1	825.1	825.1	825.1	825.1	825.1	825.1	825.1	825.1	825.1
825.2	825.2	825.2	825.2	825.2	825.2	825.2	825.2	825.2	825.2
825.3	825.3	825.3	825.3	825.3	825.3	825.3	825.3	825.3	825.3
825.4	825.4	825.4	825.4	825.4	825.4	825.4	825.4	825.4	825.4
825.5	825.5	825.5	825.5	825.5	825.5	825.5	825.5	825.5	825.5
825.6	825.6	825.6	825.6	825.6	825.6	825.6	825.6	825.6	825.6
825.7	825.7	825.7	825.7	825.7	825.7	825.7	825.7	825.7	825.7
825.8	825.8	825.8	825.8	825.8	825.8	825.8	825.8	825.8	825.8
825.9	825.9	825.9	825.9	825.9	825.9	825.9	825.9	825.9	825.9
826.0	826.0	826.0	826.0	826.0	826.0	826.0	826.0	826.0	826.0
826.1	826.1	826.1	826.1	826.1	826.1	826.1	826.1	826.1	826.1
826.2	826.2	826.2	826.2	826.2	826.2	826.2	826.2	826.2	826.2

PEAK 29977. 29657. 26631. 16403. 672189.  
 849. 840. 754. 464.  
 1.55 5.57 10.25 11.71  
 39.37 141.40 261.28 257.42  
 14706. 52822. 97602. 11166.  
 18140. 65155. 120391. 137047.

TOTAL VOLUME

MAXIMUM STORAGE = 1785.

MAXIMUM STAGE IS 834.4

\*\*\*\*\*

	PLAK	0-FT	24-FT	72-FT	TOTAL
GES	2977.	2967.	2631.	1642.	62189.
C12	849.	810.	754.	484.	19034.
I-C-ES		1.55	5.57	10.29	11.71
MM		39.37	141.40	261.28	297.42
AC-FT		14706.	52822.	97682.	111106.
TT-JLS CU M		18140.	6-155.	120391.	137047.

MAXIMUM STIFFNESS • 1785.

MAXIMUM STAGE IS 934.4

一、**總論**  
 二、**緒言**  
 三、**第一章**  
 四、**第二章**  
 五、**第三章**  
 六、**第四章**  
 七、**第五章**  
 八、**第六章**  
 九、**第七章**  
 十、**第八章**  
 十一、**第九章**  
 十二、**第十章**  
 十三、**第十一章**  
 十四、**第十二章**  
 十五、**第十三章**  
 十六、**第十四章**  
 十七、**第十五章**  
 十八、**第十六章**  
 十九、**第十七章**  
 二十、**第十八章**  
 二十一、**第十九章**  
 二十二、**第二十章**  
 二十三、**第二十一章**  
 二十四、**第二十二章**  
 二十五、**第二十三章**  
 二十六、**第二十四章**  
 二十七、**第二十五章**  
 二十八、**第二十六章**  
 二十九、**第二十七章**  
 三十、**第二十八章**  
 三十一、**第二十九章**  
 三十二、**第三十章**  
 三十三、**第三十一章**  
 三十四、**第三十二章**  
 三十五、**第三十三章**  
 三十六、**第三十四章**  
 三十七、**第三十五章**  
 三十八、**第三十六章**  
 三十九、**第三十七章**  
 四十、**第三十八章**  
 四十一、**第三十九章**  
 四十二、**第四十章**  
 四十三、**第四十一章**  
 四十四、**第四十二章**  
 四十五、**第四十三章**  
 四十六、**第四十四章**  
 四十七、**第四十五章**  
 四十八、**第四十六章**  
 四十九、**第四十七章**  
 五十、**第四十八章**  
 五十一、**第四十九章**  
 五十二、**第五十章**  
 五十三、**第五十一章**  
 五十四、**第五十二章**  
 五十五、**第五十三章**  
 五十六、**第五十四章**  
 五十七、**第五十五章**  
 五十八、**第五十六章**  
 五十九、**第五十七章**  
 六十、**第五十八章**  
 六十一、**第五十九章**  
 六十二、**第六十章**  
 六十三、**第六十一章**  
 六十四、**第六十二章**  
 六十五、**第六十三章**  
 六十六、**第六十四章**  
 六十七、**第六十五章**  
 六十八、**第六十六章**  
 六十九、**第六十七章**  
 七十、**第六十八章**  
 七十一、**第六十九章**  
 七十二、**第七十章**  
 七十三、**第七十一章**  
 七十四、**第七十二章**  
 七十五、**第七十三章**  
 七十六、**第七十四章**  
 七十七、**第七十五章**  
 七十八、**第七十六章**  
 七十九、**第七十七章**  
 八十、**第七十八章**  
 八十一、**第七十九章**  
 八十二、**第八十章**  
 八十三、**第八十一章**  
 八十四、**第八十二章**  
 八十五、**第八十三章**  
 八十六、**第八十四章**  
 八十七、**第八十五章**  
 八十八、**第八十六章**  
 八十九、**第八十七章**  
 九十、**第八十八章**  
 九十一、**第八十九章**  
 九十二、**第九十章**  
 九十三、**第九十一章**  
 九十四、**第九十二章**  
 九十五、**第九十三章**  
 九十六、**第九十四章**  
 九十七、**第九十五章**  
 九十八、**第九十六章**  
 九十九、**第九十七章**  
 一百、**第九十八章**  
 一百零一、**第九十九章**  
 一百零二、**第一百章**

## SUB-AREA RUNOFF COMPUTATION

CROGGAN DAM SUBBASIN - INFLOW HYDROGRAPH									
ISTAQ	ICOMP	IECON	ITAPE	JPLY	JPRY	INAME	ISTAGE	IAUTO	
CRDBSN	0	0	0	0	0	1	0	0	

HYDROGRAPH DATA		RATTC		ISAME		LOCAL	
HYDGC	IUHG	TAZEA	SNAP	TRSDA	TSPC	ISNOM	ISAME
1	0	115.10	0.	293.10	0.	0	1

SPTE	PMS	PRECIP DATA					
		R6	R12	R24	R48	R72	R96
0.	18.50	69.00	84.00	95.00	101.00	C.	0.

TRSPC COMPUTED BY THE PROGRAM IS 0.990

LOSS DATA										
LDROPT	STARR	DLTKR	RTIDL	ERAIN	STRSK	RTIDK	STRTL	CNSTL	ALSHX	RTIMP
0	C.	0.	1.00	0.	0.	1.00	1.00	0.10	0.	0.

UNIT HYDROGRAPH DATA  
TC= 7.40 R= 6.87 NTA= 0

RECESSION DATA  
 STRTQ= 292.00 QRC5H= 292.00 RTICR= 1.00

UNIT HYDROGRAPH 21 END-OF-PERIOD ORDINATES, LAG= 6.38 HOURS, CP= C.56 VOL= 1.00				
937.	3338.	5720.	3939.	2938.
907.	618.	506.	377.	281.
			210.	157.
			117.	87.
			2151.	1634.
				1219.
				65.

0	HR,DA	PERIOD	RAIN	EXCS	LOSS	COMP 3	END-OF-PERIOD FLOW	HR,DA	PERIOD	RAIN	EXCS	LOSS	COMP 6
	1.01	2.00	1	0.02	0.	0.02	292.	1.05	2.00	49	0.	0.	292.
	1.01	4.00	2	0.02	0.	0.02	292.	1.05	4.00	50	0.	0.	292.
	1.01	6.00	3	0.02	0.	0.02	292.	1.05	6.00	51	0.	0.	292.
	1.01	8.00	4	0.05	0.	0.05	292.	1.05	8.00	52	0.	0.	292.
	1.01	10.00	5	0.05	0.	0.05	292.	1.05	10.00	53	0.	0.	292.
	1.01	12.00	6	0.05	0.	0.05	292.	1.05	12.00	54	0.	0.	292.
	1.01	14.00	7	0.19	0.	0.19	292.	1.05	14.00	55	0.	0.	292.
	1.01	16.00	8	0.31	0.	0.33	292.	1.05	16.00	56	0.	0.	292.
	1.01	18.00	9	0.15	0.	0.15	292.	1.05	18.00	57	0.	0.	292.
	1.01	20.00	10	0.02	0.	0.02	292.	1.05	20.00	58	0.	0.	292.
	1.01	22.00	11	0.02	0.	0.02	292.	1.05	22.00	59	0.	0.	292.
	1.02	0.	12	0.02	0.	0.02	292.	1.06	0.	60	0.	0.	292.
	1.02	2.00	13	0.24	0.04	0.20	379.	1.06	2.00	61	0.	0.	292.
	1.02	4.00	14	0.24	0.04	0.20	463.	1.06	4.00	62	0.	0.	292.
	1.02	6.00	15	0.24	0.04	0.20	695.	1.06	6.00	63	0.	0.	292.
	1.02	8.00	16	0.82	0.62	0.20	1502.	1.06	8.00	64	0.	0.	292.

PERIOD	RAINF	EXCS	LOSS	COMP	MO.DA	PR.PA	PERIOD	RAINF	EXCS	LESS	COMP
1.01 2.00	1 0.02	0.	0.02	292.	1.05 2.00	2.00	49	0.	0.	0.	292.
1.01 4.00	2 0.02	0.	0.02	292.	1.05 4.00	4.00	50	0.	0.	0.	292.
1.01 6.00	3 0.02	0.	0.02	292.	1.05 6.00	6.00	51	0.	0.	0.	292.
1.01 8.00	4 0.05	0.	0.05	292.	1.05 8.00	8.00	52	0.	0.	0.	292.
1.01 10.00	5 0.05	0.	0.05	292.	1.05 10.00	10.00	53	0.	0.	0.	292.
1.01 12.00	6 0.05	0.	0.05	292.	1.05 12.00	12.00	54	0.	0.	0.	292.
1.01 14.00	7 0.19	0.	0.19	292.	1.05 14.00	14.00	55	0.	0.	0.	292.
1.01 16.00	8 0.34	0.	0.34	292.	1.05 16.00	16.00	56	0.	0.	0.	292.
1.01 18.00	9 0.15	0.	0.15	292.	1.05 18.00	18.00	57	0.	0.	0.	292.
1.01 20.00	10 0.02	0.	0.02	292.	1.05 20.00	20.00	58	0.	0.	0.	292.
1.01 22.00	11 0.02	0.	0.02	292.	1.05 22.00	22.00	59	0.	0.	0.	292.
1.02 0.	12 0.02	0.	0.02	292.	1.06 0.	0.	60	0.	0.	0.	292.
1.02 2.00	13 0.24	0.04	0.20	379.	1.06 2.00	2.00	61	0.	0.	0.	292.
1.02 4.00	14 0.24	0.04	0.20	463.	1.06 4.00	4.00	62	0.	0.	0.	292.
1.02 6.00	15 0.24	0.04	0.20	595.	1.06 6.00	6.00	63	0.	0.	0.	292.
1.02 8.00	16 0.42	0.62	0.20	1502.	1.06 8.00	8.00	64	0.	0.	0.	292.
1.02 10.00	17 0.82	0.62	0.20	3666.	1.06 10.00	10.00	65	0.	0.	0.	292.
1.02 12.00	18 0.82	0.62	0.20	7160.	1.06 12.00	12.00	66	0.	0.	0.	292.
1.02 14.00	19 2.95	2.75	0.20	12972.	1.06 14.00	14.00	67	0.	0.	0.	292.
1.02 16.00	20 6.02	5.82	0.20	26125.	1.06 16.00	16.00	68	0.	0.	0.	292.
1.02 18.00	21 2.39	2.19	0.20	47507.	1.06 18.00	18.00	69	0.	0.	0.	292.
1.02 20.00	22 0.36	0.16	0.20	66300.	1.06 20.00	20.00	70	0.	0.	0.	292.
1.02 22.00	23 0.36	0.16	0.20	70772.	1.06 22.00	22.00	71	0.	0.	0.	292.
1.03 0.	24 0.36	0.16	0.20	61702.	1.07 0.	0.	72	0.	0.	0.	292.
1.03 2.00	25 0.	0.	0.	48525.	1.07 2.00	2.00	73	0.	0.	0.	292.
1.03 4.00	26 0.	0.	0.	37263.	1.07 4.00	4.00	74	0.	0.	0.	292.
1.03 6.00	27 0.	0.	0.	23294.	1.07 6.00	6.00	75	0.	0.	0.	292.
1.03 8.00	28 0.	0.	0.	21267.	1.07 8.00	8.00	76	0.	0.	0.	292.
1.03 10.00	29 0.	0.	0.	15936.	1.07 10.00	10.00	77	0.	0.	0.	292.
1.03 12.00	30 0.	0.	0.	11961.	1.07 12.00	12.00	78	0.	0.	0.	292.
1.03 14.00	31 0.	0.	0.	6995.	1.07 14.00	14.00	79	0.	0.	0.	292.
1.03 16.00	32 0.	0.	0.	6784.	1.07 16.00	16.00	80	0.	0.	0.	292.
1.03 18.00	33 0.	0.	0.	5134.	1.07 18.00	18.00	81	0.	0.	0.	292.
1.03 20.00	34 0.	0.	0.	3902.	1.07 20.00	20.00	82	0.	0.	0.	292.
1.03 22.00	35 0.	0.	0.	2953.	1.07 22.00	22.00	83	0.	0.	0.	292.
1.04 0.	36 0.	0.	0.	2298.	1.08 0.	0.	84	0.	0.	0.	292.
1.04 2.00	37 0.	0.	0.	1765.	1.08 2.00	2.00	85	0.	0.	0.	292.
1.04 4.00	38 0.	0.	0.	1368.	1.08 4.00	4.00	86	0.	0.	0.	292.
1.04 6.00	39 0.	0.	0.	1072.	1.08 6.00	6.00	87	0.	0.	0.	292.
1.04 8.00	40 0.	0.	0.	775.	1.08 8.00	8.00	88	0.	0.	0.	292.
1.04 10.00	41 0.	0.	0.	442.	1.08 10.00	10.00	89	0.	0.	0.	292.
1.04 12.00	42 0.	0.	0.	325.	1.08 12.00	12.00	90	0.	0.	0.	292.
1.04 14.00	43 0.	0.	0.	310.	1.08 14.00	14.00	91	0.	0.	0.	292.
1.04 16.00	44 0.	0.	0.	300.	1.08 16.00	16.00	92	0.	0.	0.	292.
1.04 18.00	45 0.	0.	0.	292.	1.03 18.00	18.00	93	0.	0.	0.	292.
1.04 20.00	46 0.	0.	0.	292.	1.08 20.00	20.00	94	0.	0.	0.	292.
1.04 22.00	47 0.	0.	0.	292.	1.08 22.00	22.00	95	0.	0.	0.	292.
1.05 0.	48 0.	0.	0.	292.	1.09 0.	0.	96	0.	0.	0.	292.

SUM 16.63 13.24 3.39 517640.  
( 422.)( 336.)( 86.)(14657.93)

CFS  
 CMS  
 1" CHES  
 MM  
 AC-FT  
 TADLS CU H  
 PEAK 70772.  
 2004.  
 6-HOUR 63892.  
 1809.  
 24-HOUR 37225.  
 1054.  
 72-HOUR 13892.  
 393.  
 TOTAL VOLUME 517347.  
 14650.  
 13.94  
 354.01  
 85512.  
 105477.



	PEAK DATA FOR PLAC. 1, RYL 6									
	24.	29.	24.	29.	24.	29.	24.	29.	24.	29.
CFS	7077.	6389.	3722.	1389.	39.	1.35	1.39	35.40	8551.	10548.
CMS	200.	181.	105.	39.	1.20	30.57	7383.	9107.		
INCHES		0.52								
MM		13.12								
AC-FT		3168.								
TT-DLS CU M		3908.								

[illegible][illegible]

## COMBINE HYDROGRAPHS

## COMBINED HYDROGRAPHS AT DAM

ISTAQ ICOMP IECN ITAE JPLT JPRT INAME ISTATE IAUDD  
 CRODAM 2 0 0 0 0 1 0 0

SUM OF 2 HYDROGRAPHS AT CRODAM PLAN 1 RTIC 1

15.	15.	15.	16.	16.	17.	18.
13.	22.	29.	42.	83.	369.	1322.
2397.	3593.	3178.	2504.	2107.	1776.	1482.
1652.	1602.	1541.	1477.	1412.	1344.	1209.
1067.	951.	889.	866.	835.	759.	718.
676.	594.	556.	519.	484.	452.	365.
341.	256.	276.	251.	240.	225.	196.
172.	151.	142.	133.	125.	118.	98.
93.	83.	79.	75.	71.	68.	58.
56.	51.	49.	47.	46.	44.	35.

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME  
 3593. 2225. 1418. 59546.  
 102. 63. 40. 1686.  
 0.10 0.28 0.54 0.63  
 2.62 7.17 13.71 16.00  
 1609. 4413. 6436. 5942.  
 1985. 5444. 10406. 12140.

CFS  
 CMS  
 INCHES  
 MM  
 AC-FT  
 THOLS CU M

SUM OF 2 HYDROGRAPHS AT CRODAM PLAN 1 RTIC 2

18.	18.	18.	19.	20.	20.	21.
22.	26.	35.	50.	100.	443.	1587.
2876.	4311.	3013.	3101.	2530.	2138.	2072.
2055.	1526.	1551.	1774.	1696.	1614.	1365.
1282.	1139.	1073.	1009.	953.	511.	831.
793.	708.	664.	622.	581.	542.	435.
410.	356.	332.	310.	289.	270.	221.
207.	182.	170.	160.	150.	141.	118.
112.	100.	95.	90.	85.	81.	70.
67.	64.	59.	57.	55.	51.	40.

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME  
 4311. 2705. 1703. 71524.  
 122. 77. 48. 2025.  
 0.12 0.34 0.65 0.76  
 3.14 8.74 16.47 19.22  
 1931. 5373. 10132. 11822.  
 2382. 6628. 12498. 14582.

CFS  
 CMS  
 INCHES  
 MM  
 AC-FT  
 THOLS CU M

SUM OF 2 HYDROGRAPHS AT CRODAM PLAN 1 RTIC 3

20.	21.	21.	22.	23.	24.	25.
25.	30.	41.	53.	117.	517.	1851.
3356.	5030.	4449.	3618.	2953.	2311.	2468.
2409.	2245.	2162.	2072.	1980.	1886.	1600.
1499.	1332.	1254.	1179.	1108.	976.	898.
875.	806.	764.	723.	675.	632.	514.
479.	417.	389.	363.	339.	316.	259.
242.	213.	199.	187.	176.	165.	147.
131.	124.	111.	105.	100.	95.	86.
79.	75.	69.	67.	64.	61.	50.

CFS  
 CMS  
 INCHES  
 MM  
 AC-FT  
 THOLS CU M

	PEAK	5-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5030.	4544.	3194.	1998.	43527.
CMS	142.	129.	91.	56.	2365.
I. CUES		0.14	0.41	0.76	0.80
MM		3.00	10.30	19.24	22.44
AC-FT		2253.	6335.	11832.	13066.
TP-OLS CU M		2779.	7913.	14555.	17030.

[illegible]

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
CFS	5748.	5193.	3675.	2273.	9546R.	
CMS	163.	147.	104.	66.	2764.	
INCHES		0.16	0.47	0.87	1.01	
MM		4.19	11.85	21.59	25.66	
AC-FT		2575.	7290.	13526.	15783.	
TOTALS CU M		3176.	8992.	16684.	19468.	

[illegible]

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CF3	6467.	5842.	4152.	2557.	107370.
CH3	183.	165.	118.	72.	3041.
1° CH3		0.19	0.53	0.97	1.14
MM		4.71	13.39	24.74	28.45
AC-FT		2897.	4235.	15217.	17749.
TFOLS CU M		3573.	10158.	18765.	21852.

[illegible]

## SUM OF 2 HYDROGRAPHS AT CROGHAN PLAN 1 RTIC 7

147.	146.	149.	152.	156.	160.	165.	170.	175.
181.	188.	291.	413.	834.	1528.	3050.	6615.	13221.
23969.	33447.	32695.	28155.	24885.	22788.	21335.	20184.	16537.
17885.	16540.	15048.	14181.	13374.	12555.	11547.	11130.	10420.
9785.	9947.	8153.	7031.	7149.	6654.	6254.	5905.	5619.
5313.	5077.	4437.	4176.	3931.	3701.	3466.	3285.	3104.
2968.	2638.	2542.	2397.	2261.	2125.	1953.	1867.	1746.
1639.	1537.	1356.	1274.	1199.	1130.	1071.	1032.	1013.
985.	913.	872.	831.	791.	752.	715.	681.	649.
610.	591.	541.	519.	498.				

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	36065.	33194.	24621.	14331.	544575.
CMS	1021.	940.	697.	406.	16826.
INCHES		1.05	3.13	5.46	6.29
MM		26.76	79.39	138.64	159.77
AC-FT		16460.	48836.	85278.	58277.
TOTALS CU M		20305.	60236.	105188.	121223.

## SUM OF 2 HYDROGRAPHS AT CROGHAN PLAN 1 RTIC 8

292.	293.	299.	304.	311.	320.	329.	339.	350.
363.	377.	583.	835.	1667.	3857.	7350.	13230.	26442.
47956.	73255.	67287.	59123.	53798.	45867.	46811.	44046.	41517.
38973.	34140.	31913.	29773.	27661.	25629.	23727.	22064.	20491.
18806.	17375.	15024.	14005.	13000.	12121.	11333.	10586.	9559.
9411.	8775.	7575.	7041.	6552.	6141.	5838.	5522.	5210.
4915.	4639.	4137.	3809.	3695.	3495.	3311.	3161.	3042.
2902.	2757.	2492.	2352.	2224.	2100.	1963.	1874.	1772.
1678.	1591.	1434.	1364.	1300.	1241.	1156.	1171.	1151.
1124.	1072.	1020.	984.	949.				

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	73255.	67094.	51772.	29264.	1165336.
CMS	2074.	1923.	1466.	825.	33684.
INCHES		2.15	6.57	11.15	12.58
MM		54.73	166.94	283.09	319.64
AC-FT		38666.	102687.	174135.	196618.
TOTALS CU M		41527.	126663.	214792.	242524.

\*\*\*\*\*

## HYDROGRAPH ROUTING

ROUTED OUTFLOW - CROGHAN DAM - SPILLCREST ELEV 825									
ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRP	INAME	ISTAGE	IAUTO	
CROGHAN	1	0	0	0	0	1	0	0	
ROUTING DATA									
QLOSS	CLOSS	AVG	IRFS	ISAME	IOPT	IPPP	LSTR		
0.	0.	0.	1	1	0	0			
NSTPS	NSTDL	LAG	AMSKK	X	TSK	STCRN	ISPRAT		
1	0	0	0.	0.	0.	-825.	-1		

STAGE	825.00	825.20	825.50	826.00	826.50	827.00	827.50	828.00	828.50
	829.00	829.50	829.50	829.80					

## HYDROGRAPH ROUTING

## ROUTED OUTFLOW - CROGHAN DAM - SPILLCREST ELEV 825

ISTAO	ICOMP	ITYPE	JPLT	JPRY	INAME	ISTAGE	IAUTO			
0	0	0	0	0	1	0	0			
ROUTING DATA										
IRIS	ISAME	IOPT	IPPP	LSTR						
1	1	0	0	0						
STPS	YSTOL	LAG	AMSKK	X	TSK	STERA	ISPRAT			
1	0	0	0	0	0	-825.	-1			
STAGE	825.00	825.20	825.50	826.00	826.50	827.00	827.50	828.00	828.30	828.50
	828.60	829.00	829.50	829.80	829.90	829.90	829.90	829.90	829.90	829.90
FLOW	292.00	363.00	572.00	1079.00	1599.00	2220.00	2924.00	3701.00	4197.00	4429.00
	4560.00	4890.00	5545.00	6031.00	6031.00	6031.00	6031.00	6031.00	6031.00	6031.00

CREL SPWID<sup>2</sup> COQM EXPW ELEV CCCL CAREA EXPL  
825.0 0. 0. 0. 0. 0. 0.

DAM DATA  
TOPEL COQD EXPD CAPAC  
829.8 3.2 1.5 207.

## STATION CROGHAN, PLAN 1, RATIO 1

## END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW									
292.	292.	292.	292.	292.	292.	292.	292.	292.	292.
292.	292.	292.	292.	292.	292.	292.	292.	292.	292.
1998.	3112.	3586.	3320.	2745.	2234.	1677.	1028.	464.	1034.
1602.	1673.	1617.	1565.	1502.	1437.	1370.	1302.	1235.	1495.
1095.	1028.	972.	926.	897.	875.	848.	814.	775.	1167.
692.	651.	610.	571.	543.	504.	470.	438.	409.	734.
353.	292.	319.	299.	292.	292.	292.	292.	292.	381.
292.	292.	292.	292.	292.	292.	292.	292.	292.	292.
292.	292.	292.	292.	292.	292.	292.	292.	292.	292.
STORAGE									
482.	482.	482.	482.	482.	482.	482.	482.	482.	482.
482.	482.	482.	482.	482.	482.	482.	482.	482.	482.
602.	634.	674.	663.	633.	614.	555.	562.	505.	545.
581.	584.	581.	578.	574.	570.	566.	562.	557.	574.
549.	544.	541.	538.	536.	534.	533.	530.	528.	553.
523.	520.	517.	515.	512.	508.	505.	502.	499.	525.
494.	491.	487.	483.	482.	482.	482.	482.	482.	497.
482.	482.	482.	482.	482.	482.	482.	482.	482.	482.
482.	482.	482.	482.	482.	482.	482.	482.	482.	482.
482.	482.	482.	482.	482.	482.	482.	482.	482.	482.
STAGE									
825.0	825.0	825.0	825.0	825.0	825.0	825.0	825.0	825.0	825.0
825.0	825.0	825.0	825.0	825.0	825.0	825.0	825.0	825.0	825.0
826.8	827.6	827.9	827.8	827.4	827.0	826.7	826.5	826.4	826.4
826.5	826.6	826.5	826.5	826.4	826.3	826.3	826.2	826.1	826.1
826.0	826.0	825.9	825.8	825.8	825.8	825.8	825.7	825.7	825.7
825.6	825.6	825.5	825.5	825.5	825.4	825.4	825.3	825.3	825.2



PEAK OUTFLOW IS 7339. AT TIME 46.00 HOURS

THOUS CU M	CFS	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
825.0	7339.	6540.	4605.	2842.	125787.
825.0	208.	185.	130.	RC.	3562.
825.0		0.21	0.58	1.08	1.33
825.0		5.27	14.85	27.49	33.80
825.0		3243.	9133.	16910.	20761.
825.0		4000.	11265.	20858.	25646.

STATION CRODAP, PLAN 1, RATIC 7  
END-OF-PERIOD HYDROGRAPH ORDINATES

THOUS CU M	CFS	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
825.0	7339.	6540.	4605.	2842.	125787.
825.0	208.	185.	130.	RC.	3562.
825.0		0.21	0.58	1.08	1.33
825.0		5.27	14.85	27.49	33.80
825.0		3243.	9133.	16910.	20761.
825.0		4000.	11265.	20858.	25646.

STORAGE

THOUS CU M	CFS	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
825.0	7339.	6540.	4605.	2842.	125787.
825.0	208.	185.	130.	RC.	3562.
825.0		0.21	0.58	1.08	1.33
825.0		5.27	14.85	27.49	33.80
825.0		3243.	9133.	16910.	20761.
825.0		4000.	11265.	20858.	25646.

STAGE

THOUS CU M	CFS	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
825.0	7339.	6540.	4605.	2842.	125787.
825.0	208.	185.	130.	RC.	3562.
825.0		0.21	0.58	1.08	1.33
825.0		5.27	14.85	27.49	33.80
825.0		3243.	9133.	16910.	20761.
825.0		4000.	11265.	20858.	25646.

PEAK OUTFLOW IS 36129. AT TIME 46.00 HOURS

THOUS CU M	CFS	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
825.0	36129.	33326.	24573.	14321.	555987.

PEAK OUTFLOW IS 36129. AT TIME 46.00 HOURS

CFS	36129.	24-HOUR	72-HOUR	TOTAL VOLUME
CMS	1023.	24573.	14321.	555987.
INCHES		696.	406.	16476.
MM		3.2	5.45	6.31
AC-FT		79.24	138.54	160.15
TDLS CU M		48740.	85217.	98510.
		20344.	105114.	121511.

# STATION CROOK, PLAN 1, RATIC 8

## END-OF-PERIOD HYDROGRAPH COORDINATES

	OUTFLOW			
292.	295.	299.	304.	311.
350.	499.	721.	1319.	318.
46027.	67968.	59675.	54103.	6288.
35212.	32104.	29975.	27838.	47008.
15994.	15141.	14127.	13121.	23110.
9486.	8243.	7123.	6638.	11433.
5004.	4493.	4212.	3747.	5904.
2940.	2520.	2389.	2260.	3357.
1703.	1540.	1391.	1324.	3197.
1135.	1071.	993.	963.	1804.
				1180.
				326.
				12495.
				44295.
				22223.
				10683.
				5603.
				3304.
				3071.
				1804.
				1155.

	STORAGE			
482.	483.	484.	485.	489.
493.	508.	563.	654.	957.
1493.	1837.	1670.	1548.	1469.
1398.	1329.	1262.	1197.	1137.
1081.	1031.	970.	951.	918.
591.	861.	817.	804.	780.
750.	715.	689.	672.	658.
647.	634.	621.	609.	597.
586.	577.	567.	559.	554.
551.	547.	542.	540.	533.
				491.
				1176.
				1433.
				1110.
				504.
				765.
				652.
				591.
				553.

	STAGE			
825.0	825.0	825.0	825.1	825.1
825.2	825.4	826.2	827.6	832.2
840.4	844.7	843.1	841.2	840.0
839.0	837.9	836.9	835.5	835.0
834.1	833.4	832.7	832.2	831.6
831.2	830.8	830.3	829.5	831.4
829.1	828.5	828.2	827.5	829.3
827.5	827.3	827.2	827.8	827.6
826.6	826.4	826.3	826.9	826.7
826.1	826.0	825.9	826.2	826.1
				825.1
				835.6
				839.5
				834.6
				831.6
				829.3
				827.6
				826.7
				826.1

PEAK OUTFLOW IS 73351. AT TIME 46.00 HOURS

CFS	73351.	24-HOUR	72-HOUR	TOTAL VOLUME
CMS	2077.	51698.	29258.	1189184.
INCHES		1927.	826.	33674.
MM		2.16	11.14	12.58
AC-FT		54.86	166.70	315.55
TDLS CU M		33744.	102541.	156359.
		41023.	214743.	242452.

\*\*\*\*\*

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FORMULTIPLE PLAN-RATIO ECCENTRIC COMPUTATIONS  
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)  
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS							
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8
				0.05	0.06	0.07	0.08	0.09	0.10	0.50	1.00
HYDROGRAPH AT	STIASN	178.00 (*****)	1	3403. ( 96.37)	4064. (115.64)	4764. (134.91)	5445. (154.19)	6126. (173.46)	6806. (192.73)	34032. (963.67)	68064. (1927.35)
ROUTED TO	STIDAM	178.00 (*****)	1	1366. ( 38.68)	1641. ( 46.47)	1917. ( 54.27)	2165. ( 61.42)	2409. ( 68.21)	2651. ( 75.06)	13555. ( 383.94)	30003. ( 849.58)
ROUTED TO	RIVER	178.00 (*****)	1	1345. ( 38.12)	1618. ( 45.81)	1890. ( 53.52)	2142. ( 60.66)	2380. ( 67.38)	2619. ( 74.16)	13528. ( 383.07)	29577. ( 848.66)
HYDROGRAPH AT	CROGSN	115.10 (*****)	1	3539. (100.20)	4246. (120.24)	4954. (140.28)	5662. (160.32)	6370. (180.36)	7077. (200.41)	35386. (1002.03)	70772. (2004.05)
2 COMBINED	CRODAM	293.10 (*****)	1	3593. (101.74)	4311. (122.09)	5030. (142.43)	5748. (162.78)	6467. (183.12)	7186. (203.47)	36065. (1021.26)	73255. (2074.35)
ROUTED TO	CRODAM	293.10 (*****)	1	3586. (101.55)	4293. (121.56)	4900. (138.74)	5728. (162.20)	6536. (185.08)	7339. (207.82)	36129. (1023.07)	73351. (2077.08)

## SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ..... [STILLWATER RESV. DAM]

RATIO OF PMF	MAXIMUM RESERVOIR ELEVATION OUTFLOW	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION EVEN TEP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
C-05	1679.77	0.	111447.	1366.	0.	62.00	0.
C-06	1679.87	0.	112043.	1641.	0.	62.00	0.
C-07	1679.97	0.	112640.	1917.	0.	62.00	0.
C-08	1680.05	0.	113250.	2169.	0.	62.00	0.
C-09	1680.14	0.	113668.	2409.	0.	62.00	0.
C-10	1680.22	0.	114492.	2651.	0.	62.00	0.
C-50	1683.43	0.	133767.	13559.	0.	62.00	0.
1.00	1686.72	0.	166405.	30003.	0.	60.00	0.

INITIAL VALUE  
1679.30  
108485.  
0.

SPILLWAY CREST  
1679.30  
108485.  
0.

TEP OF DAM  
1679.30  
171487.  
33193.

## PLAN 1 STATION RIVER

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
0.05	1346.	826.6	68.00
0.06	1618.	826.8	66.00
0.07	1890.	827.0	66.00
0.08	2142.	827.1	68.00
0.09	2380.	827.3	68.00
0.10	2619.	827.5	68.00
0.50	13528.	831.2	64.00
1.00	29977.	834.4	62.00

## SUMMARY OF DAM SAFETY ANALYSIS

CROGHAN DAM

FL. 1 .....

ELEVATION  
STORAGE  
OUTFLOWINITIAL VALUE  
825.00  
482.  
292.SPILLWAY CREST  
825.00  
482.  
292.TOP OF DAM  
829.80  
797.  
6031.

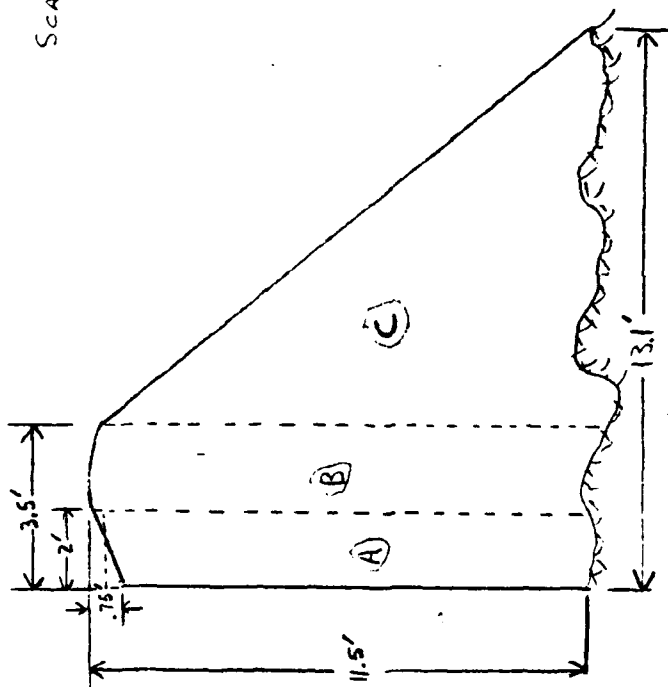
RATIO	MAXIMUM RESEV. DIA	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AS-FT	MAXIMUM OUTFLOW CFS	DURATION EVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
CP	827.93	0.	674.	3585.	0.	46.00	0.
PMF	828.38	0.	704.	4293.	0.	46.00	0.
0.85	829.01	0.	745.	4900.	0.	46.00	0.
0.66	829.61	0.	785.	5728.	0.	46.00	0.
0.47	830.06	0.26	814.	6534.	2.00	46.00	0.
0.28	830.41	0.61	837.	7339.	6.00	46.00	0.
0.09	830.79	1.49	1354.	36125.	50.00	46.00	0.
0.10	831.29	15.84	1837.	73351.	80.00	46.00	0.
0.50	845.64						
1.00							

APPENDIX D  
STABILITY COMPUTATIONS

# CROSS SECTION OF CROGHAN DAM - SPILLWAY SECTION - TAKEN FROM PLANS PREPARED BY

JAMES P. BROWNELL

SCALE  $\frac{1}{4}'' = 1'$



SECTION	AREA	DISTANCE TO CENTROID
A	$(11.12)(2) = 22.2 \text{ ft}^2$	12.1'
B	$(11.5)(1.5) = 17.2 \text{ ft}^2$	8.8'
C	$\frac{1}{2}(11.5)(9.6) = 55.2 \text{ ft}^2$	6.4'

AD-A106 087

NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/6 13/13  
NATIONAL DAM SAFETY PROGRAM. CROGHAN DAM (NORTH & SOUTH) (INVEN-ETC(U)  
APR 81 @ KOCH, W M SMITH DACWS1-79-C-0001

UNCLASSIFIED

NL

2 of 2  
200000

END

DATE

FILED

11-81

DTIC

#### ANALYSIS CONDITIONS

1. Normal conditions; water surface at spillway crest.
2. Water surface at spillway crest plus ice load of 5,000 pounds per linear foot.
3. 1/2 PMF flow; water surface 8.5 feet over top of dam.
4. Flood flows; water surface at top of dam.
5. Normal conditions with seismic coefficient of 0.10.

# STABILITY ANALYSIS PROGRAM - WORK SHEET

## INPUT ENTRY

## ANALYSIS CONDITION

		1	2	3	4	5
Unit Weight of Dam (K/ft <sup>3</sup> )	0	0.15				
Area of Segment No. 1 (ft <sup>2</sup> )	1	22.2				
Distance from Center of Gravity of Segment No. 1 to Downstream Toe (ft)	2	12.1				
Area of Segment No. 2 (ft <sup>2</sup> )	3	17.2				
Distance from Center of Gravity of Segment No. 2 to Downstream Toe (ft)	4	8.8				
Area of Segment No. 3 (ft <sup>2</sup> )	5	55.2				
Distance from Center of Gravity of Segment No. 3 to Downstream Toe (ft)	6	6.4				
Base Width of Dam (Total) (ft)	7	13.1				
Height of Dam (ft)	8	11.5				
Ice Loading (K/L ft.)	9		5.0			
Coefficient of Sliding	10	0.65				
Unit Weight of Soil (K/ft <sup>3</sup> ) (deduct 18)	11	.055				
Active Soil Coefficient - Ka	12	0.33				
Passive Soil Coefficient - Kp	13	3.0				
Height of Water over Top of Dam or Spillway (ft)	14			13.29	4.8	
Height of Soil for Active Pressure (ft)	15	10				
Height of Soil for Passive Pressure (ft)	16					
Height of Water in Tailrace Channel (ft)	17	2				
Weight of Water (K/ft <sup>3</sup> )	18	.0625				
Area of Segment No. 4 (ft <sup>2</sup> )	19					
Distance from Center of Gravity of Segment No. 4 to Downstream Toe (ft)	20					
Height of Ice Load or Active Water (ft) (does not include 14)	46	11.5				
Seismic Coefficient (g)	50					.10

## RESULTS OF ANALYSIS

Factor of Safety vs. Overturning	1.83	.96	.97	1.39	1.76
Distance From Toe to Resultant	6.06	-.57	-.28	3.77	5.8
Factor of Safety vs. Sliding	1.14	.57	.39	.68	.83

APPENDIX E

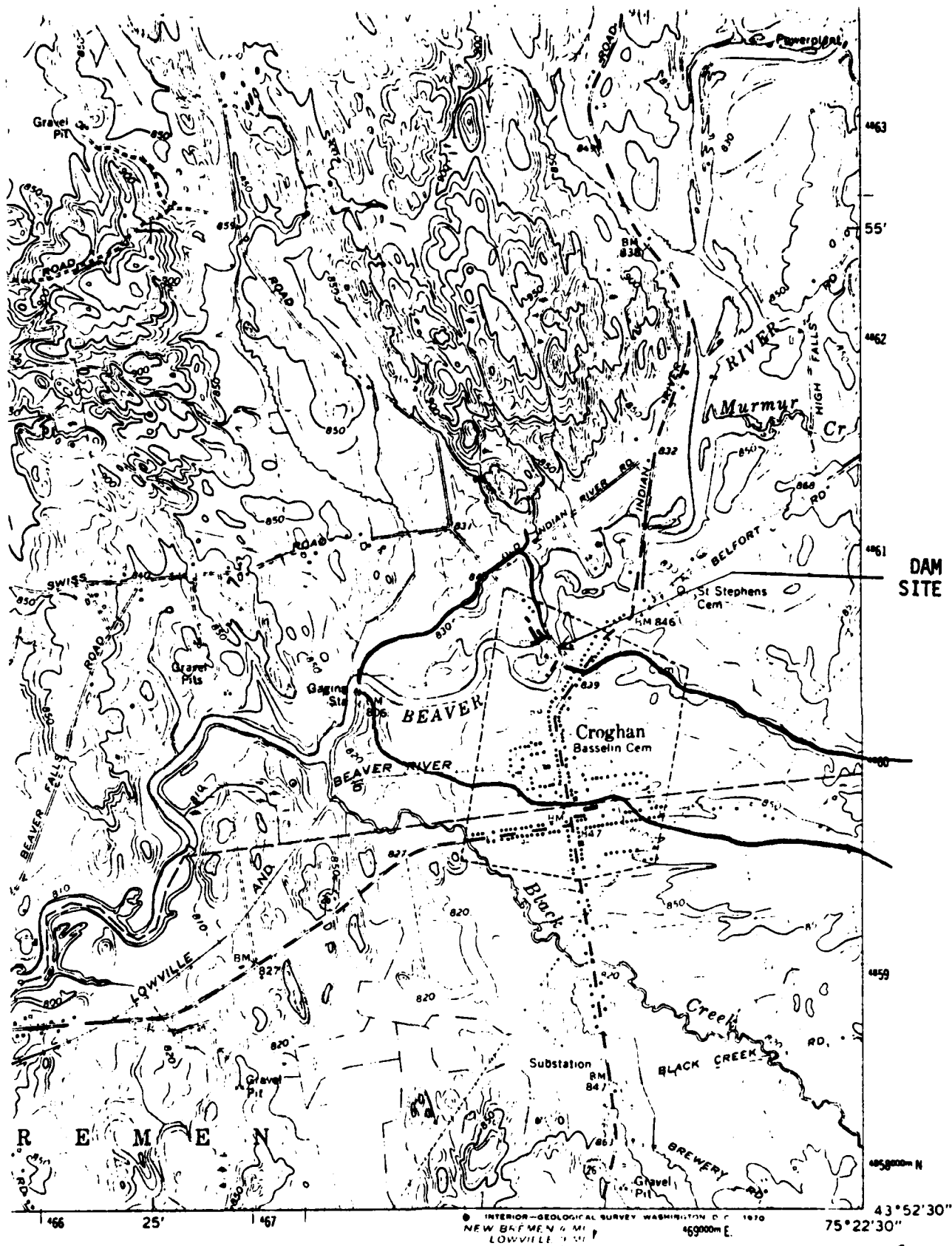
REFERENCES

APPENDIX E  
REFERENCES

1. M.G. Cline and R.L. Marshall, Soils of New York Landscapes - Information Bulletin 119, New York State College of Agriculture and Life Sciences, Cornell University August, 1977.
2. B.B. Eissler, Low-Flow Frequency Analysis of Streams in New York - Bulletin 74, U.S. Geological Survey, 1979.
3. H.W. King and E.F. Brater, Handbook of Hydraulics, 5th Edition, McGraw-Hill, 1963.
4. University of the State of New York, Geology of New York, Education Leaflet 20, reprinted 1973.
5. HEC - 1 Flood Hydrograph Package - Dam Safety Version, September 1978.
6. U.S. Army Corps of Engineers - Buffalo District:  
Black River Basin, New York; Hydrology and Economic Analysis for Flood Control of proposed Reservoirs at Hawkinsville, Forestport and Nelson Lake; June, 1974.
7. U.S. Army Corps of Engineers - New York District:  
Stillwater Reservoir Dam - Phase I Inspection Report, National Dam Safety Program, O'Brien and Gere Engineers, Inc. July, 1978.
8. U.S. Department of Agriculture, Soil Conservation Service; National Engineering Handbook; Section 4 - Hydrology, August 1972.
9. Hydrometeorological Report No. 33:  
Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for areas from 10 to 1,000 Square Miles and Durations of 6, 12, 24, and 48 Hours, April, 1956.
10. U.S. Geological Survey:  
Water Resources Data for New York - 1979; Volume 1 - Excluding Long Island.

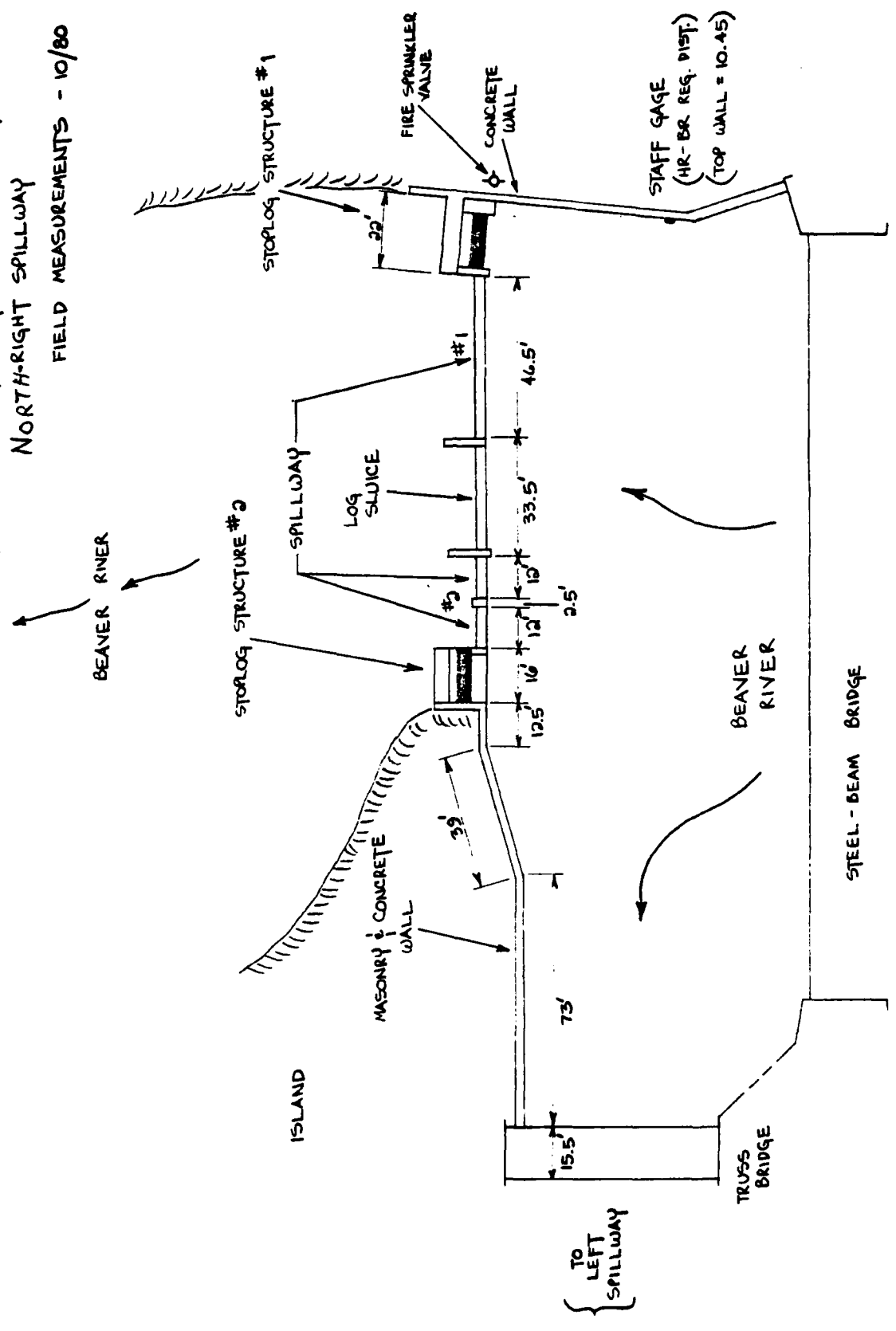
APPENDIX F

DRAWINGS



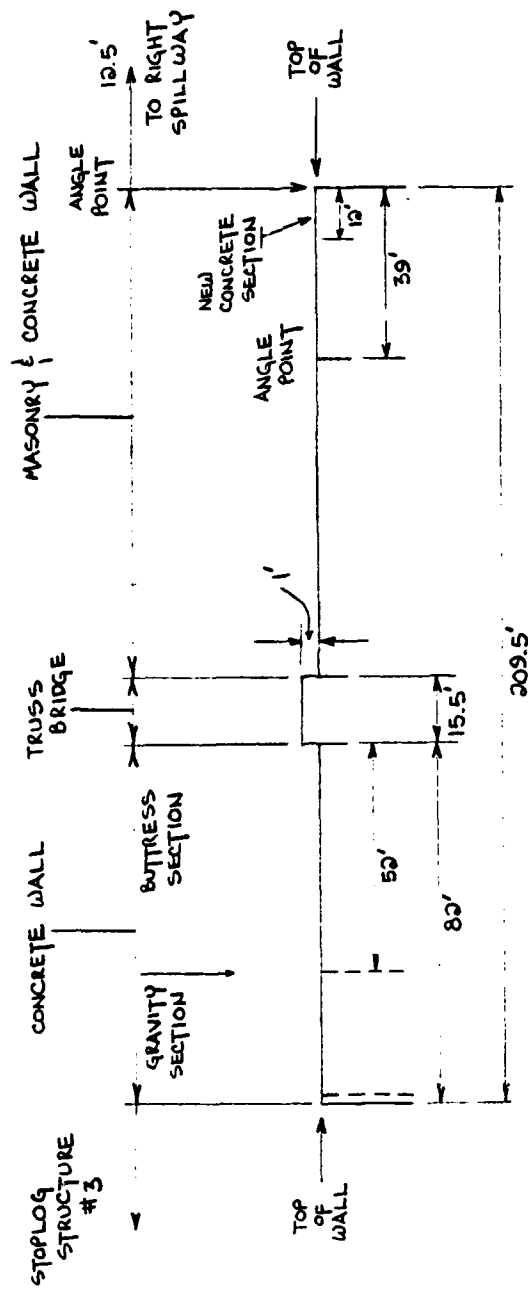
VICINITY MAP  
CROGHAN DAM  
NY-694

PLAN OF CROGHAN DAM NY-694  
 NORTH-RIGHT SPILLWAY  
 FIELD MEASUREMENTS - 10/80

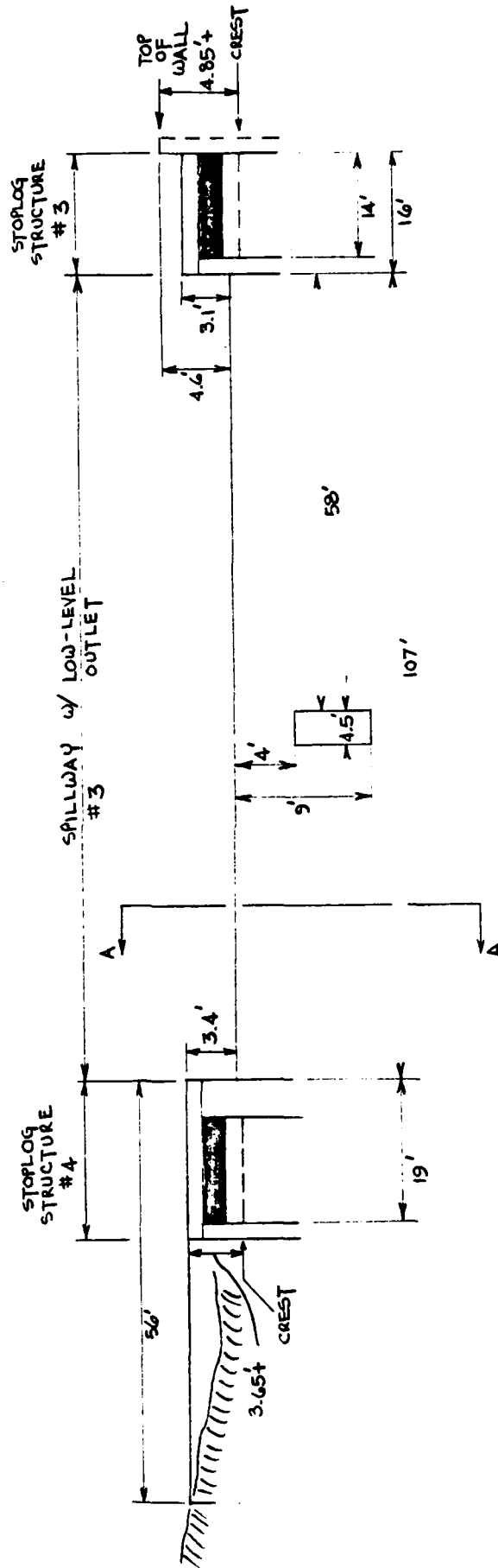




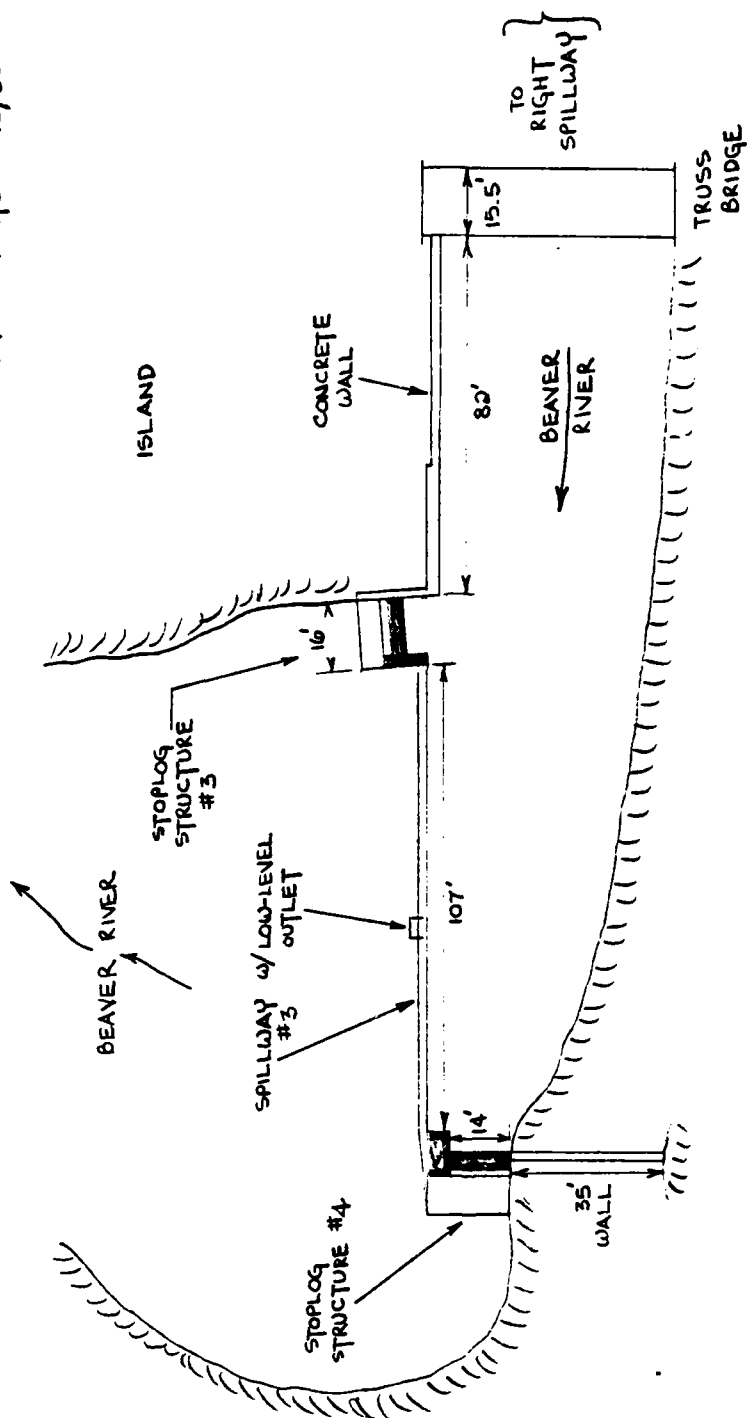
ELEVATION - CROGHAN DAM NY-694  
 WALLED SECTION - BETWEEN  
 SPILLWAYS  
 FIELD MEASUREMENTS - 10/80



ELEVATION - CROGHAN DAM NY-694  
 SOUTH - LEFT SPILLWAY  
 FIELD MEASUREMENTS - 10/80



PLAN of CROGHAN DAM NY-694  
 SOUTH - LEFT SPILLWAY  
 FIELD MEASUREMENTS - 10/80



105

100

95

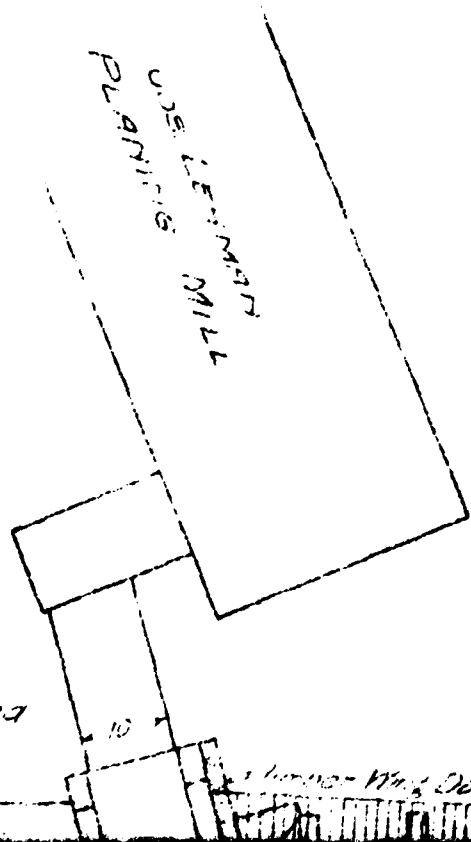
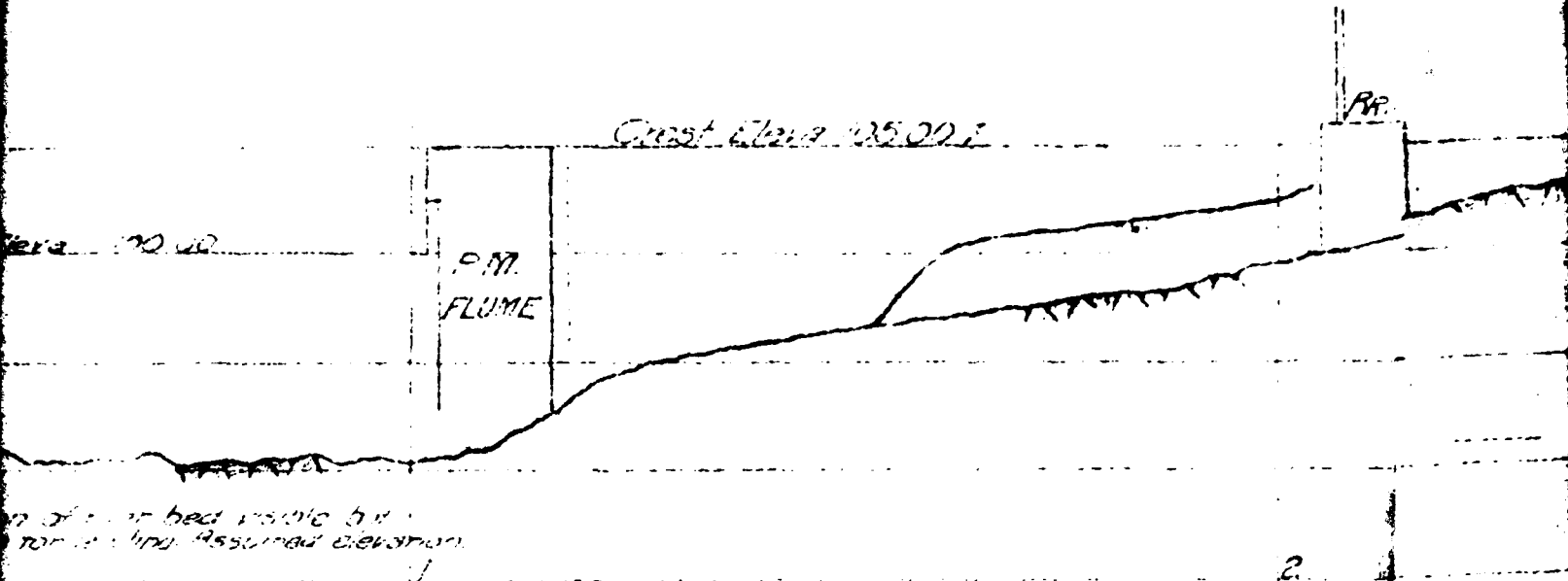
90

85

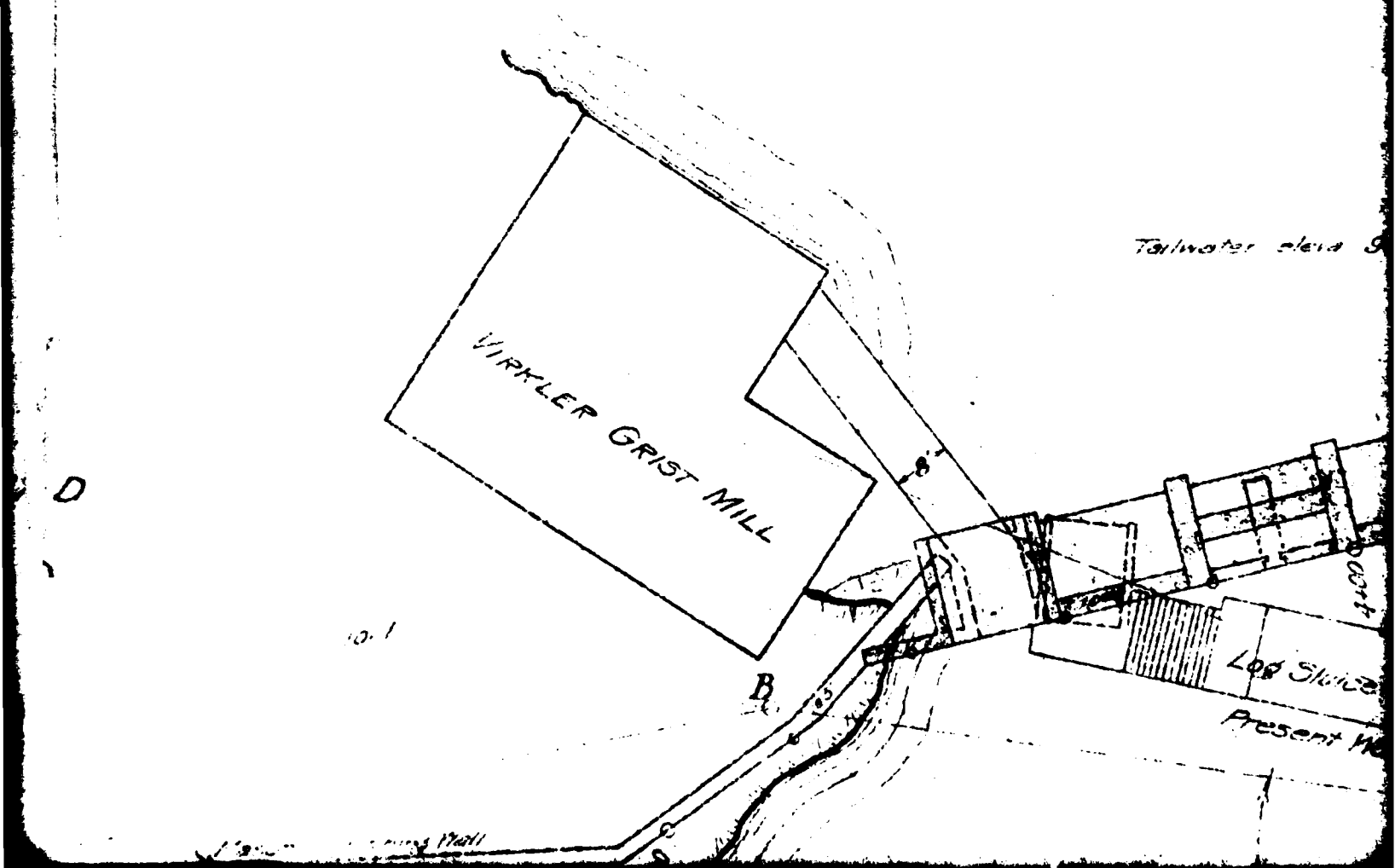
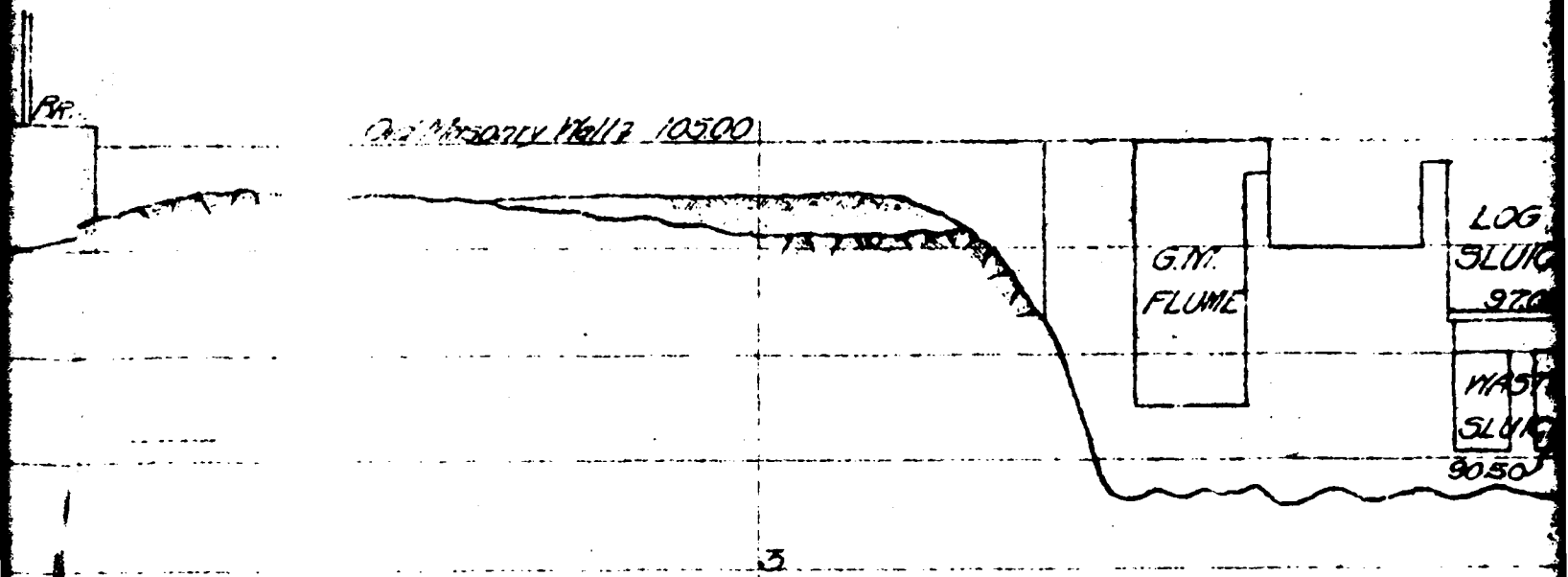
100 at Spring, Here 194

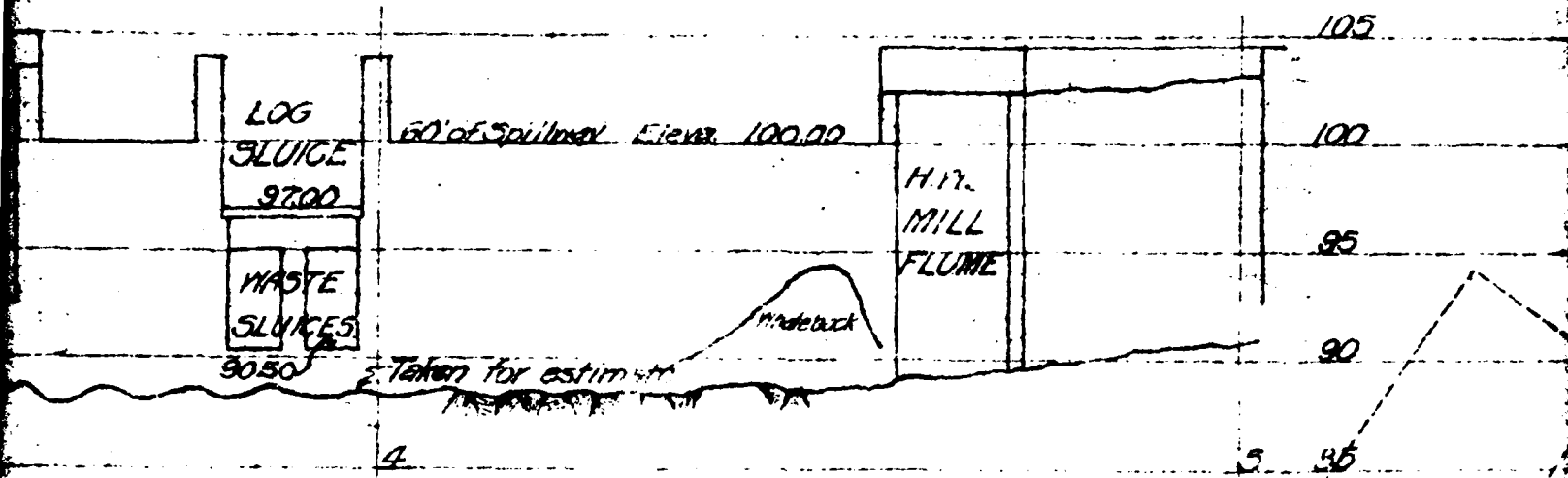
The curve is a  
and should be a line

Note: This point is a old record  
in 1940, 1941

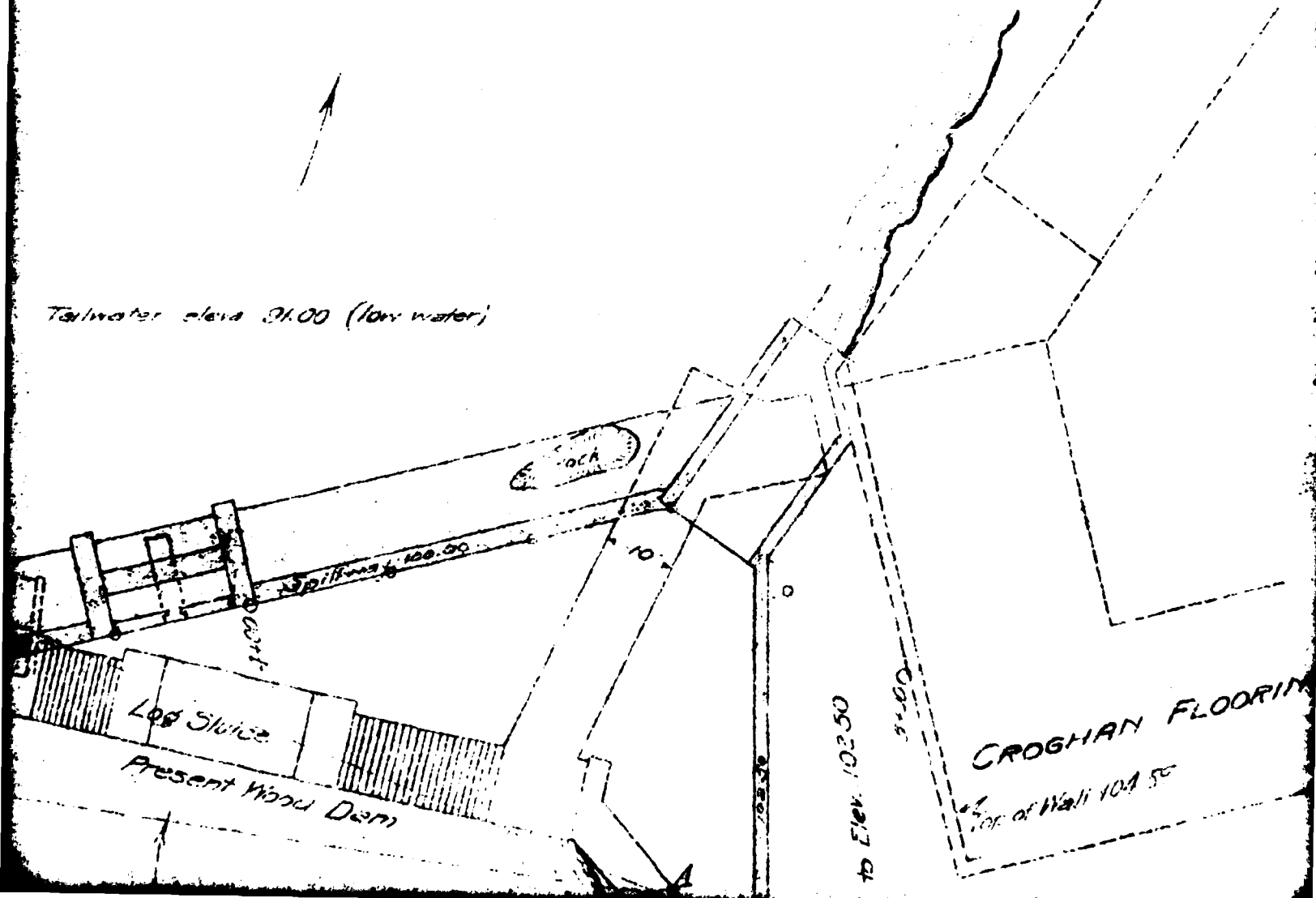


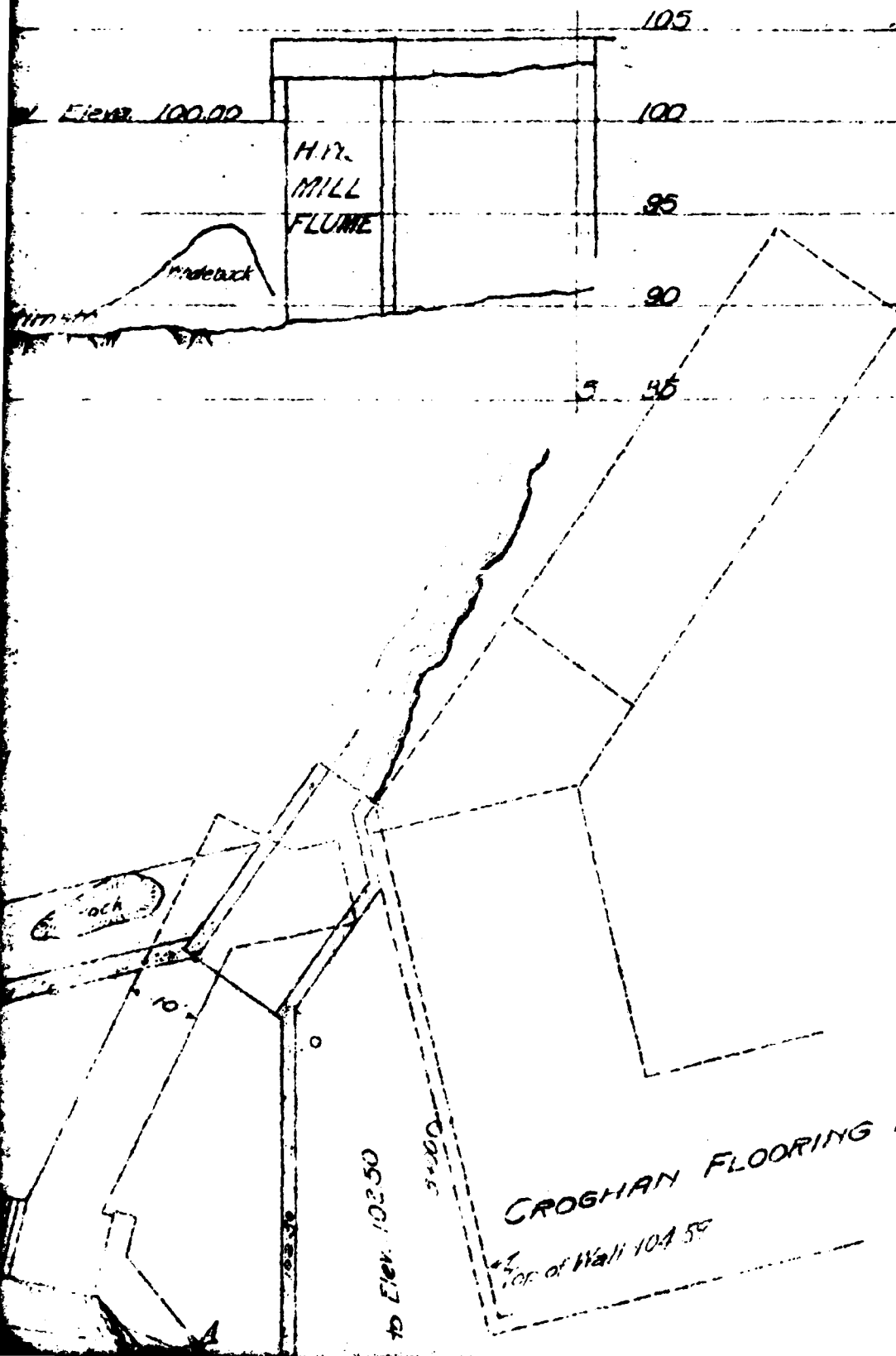
MILL ISLAND





Tailwater elev. 91.00 (low water)





1000 1000 1000  
1000 1000 1000  
1000 1000 1000

1000 1000 1000  
1000 1000 1000  
1000 1000 1000



BEAVER

Sea Level Elevation 100.00  
(approx 570 sea elevation)

BEAVER BRIDGE

RIVER

HIGHWAY BRIDGE

Notes:

Discard all items

5/5/64

Onward, starting 1/2 mi. from North Pres.

BRIDGE

GENERAL PLAN

PROPOSED NEW DAM  
BEAVER RIVER  
CROGHAN, N.Y.

Town of Croghan, County of Lewis, S.

Scales 20 Horizontal

8 Vertical

May 10, 1908

Drawn by

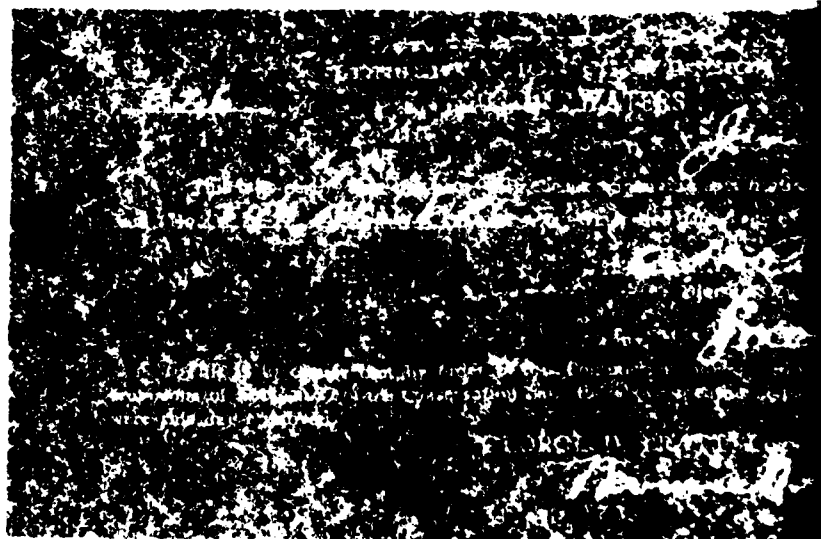
7216

7/10/11

James

Eng.

North arrow



GENERAL PLAN

PROPOSED NEW DAM ON THE  
BEAVER RIVER  
IN CROGHAN, N.Y.

Town of Croghan, County of Lewis, State of New York

Surveyed by Horatio B.

& Vertical

May 17, 1908

Drawing by

7216

May 17, 1908

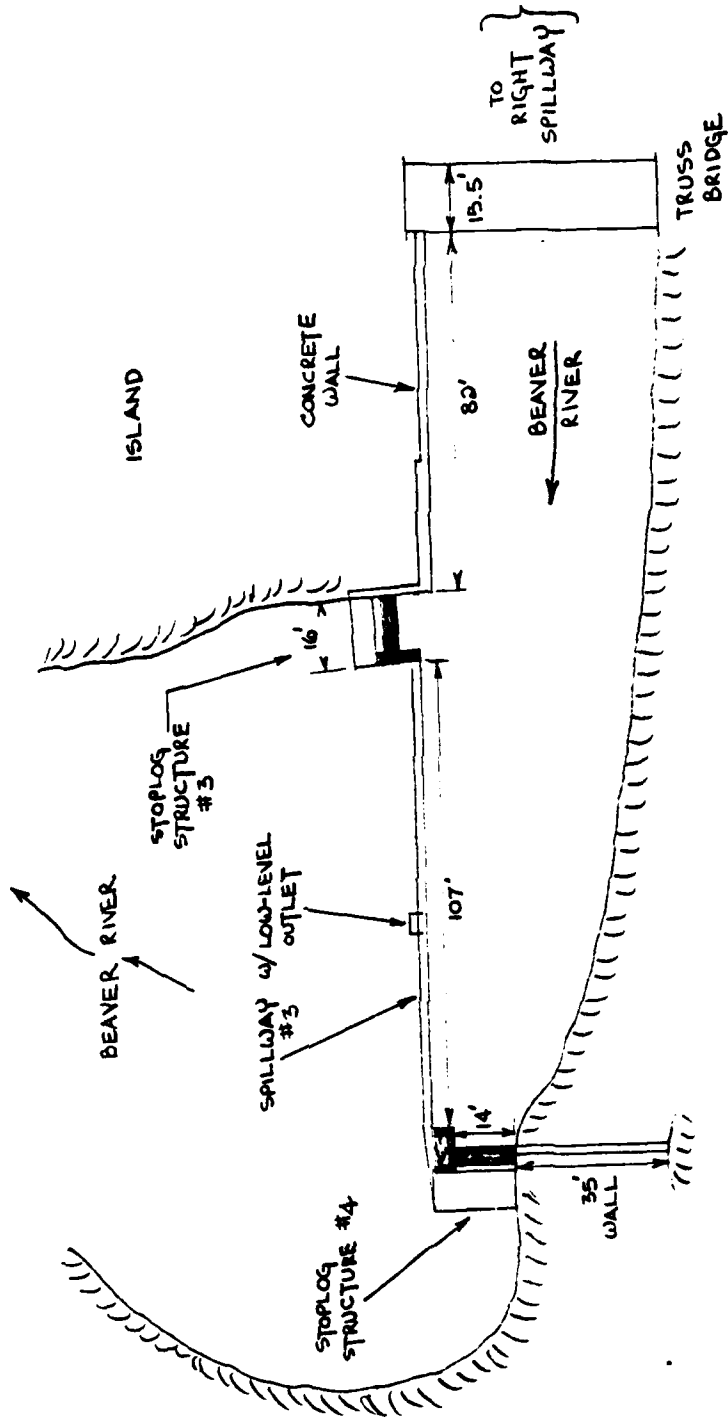
James F. Brownell, Jr.

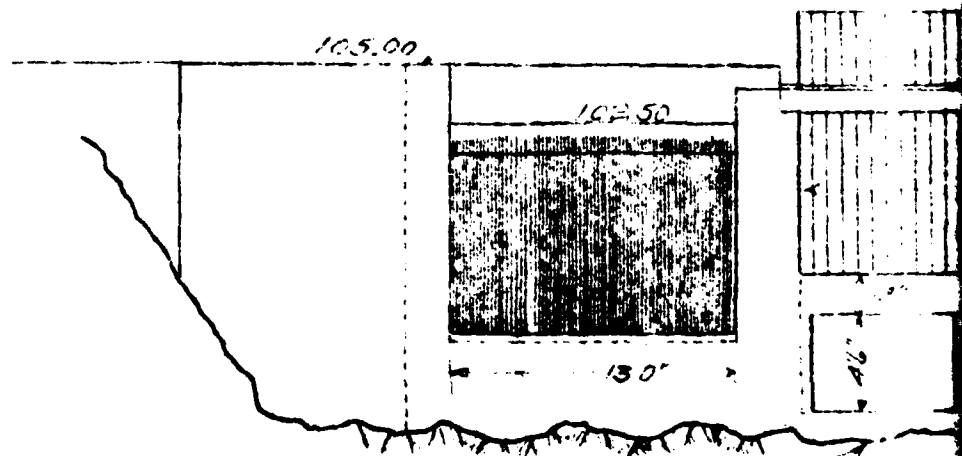
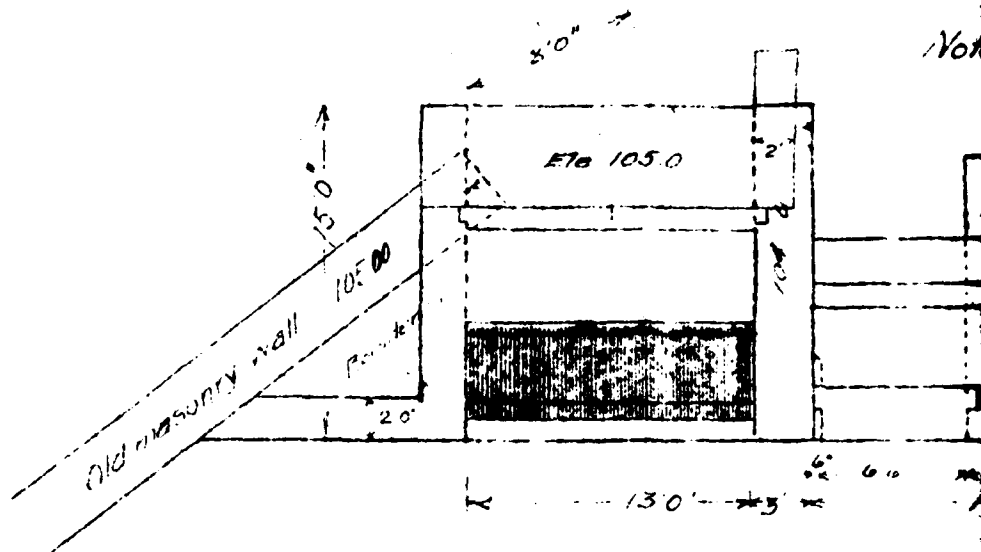
Engineer

Croghan, N.Y.



PLAN of CROGHAN DAM NY-694  
 SOUTH - LEFT SPILLWAY  
 FIELD MEASUREMENTS - 10/80



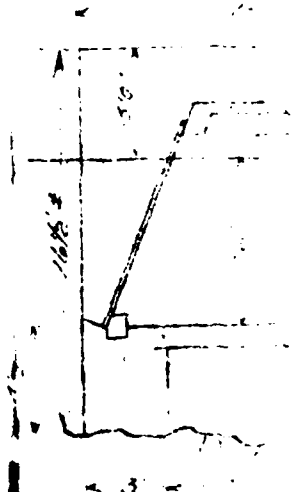
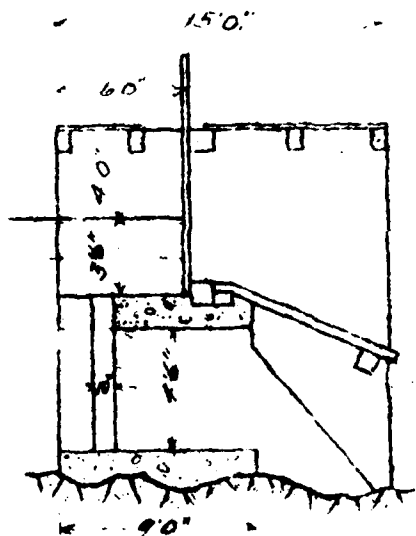
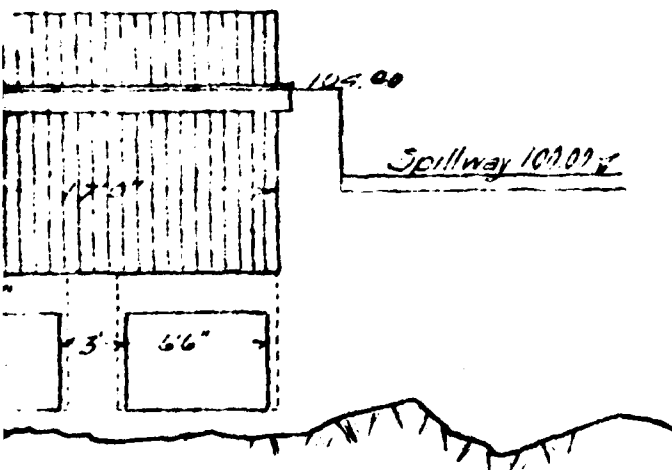
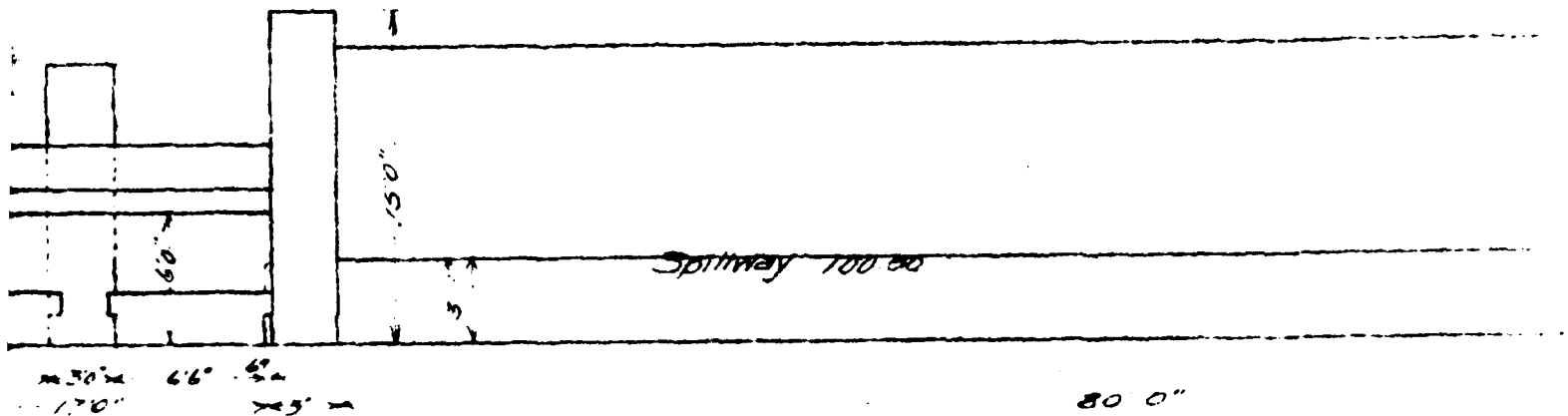


Note: E

GRIST MILL BUE

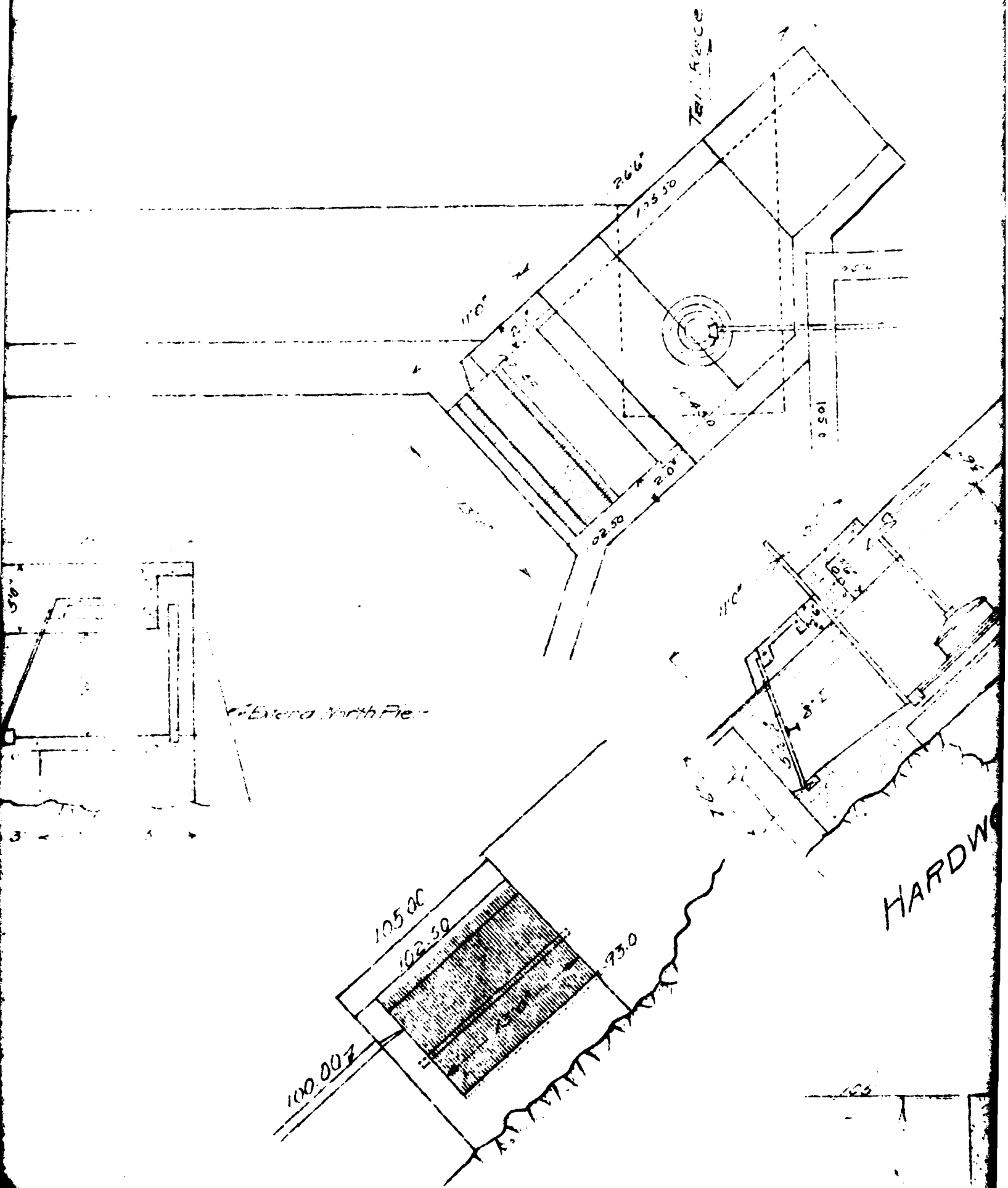
# NORTH DAM

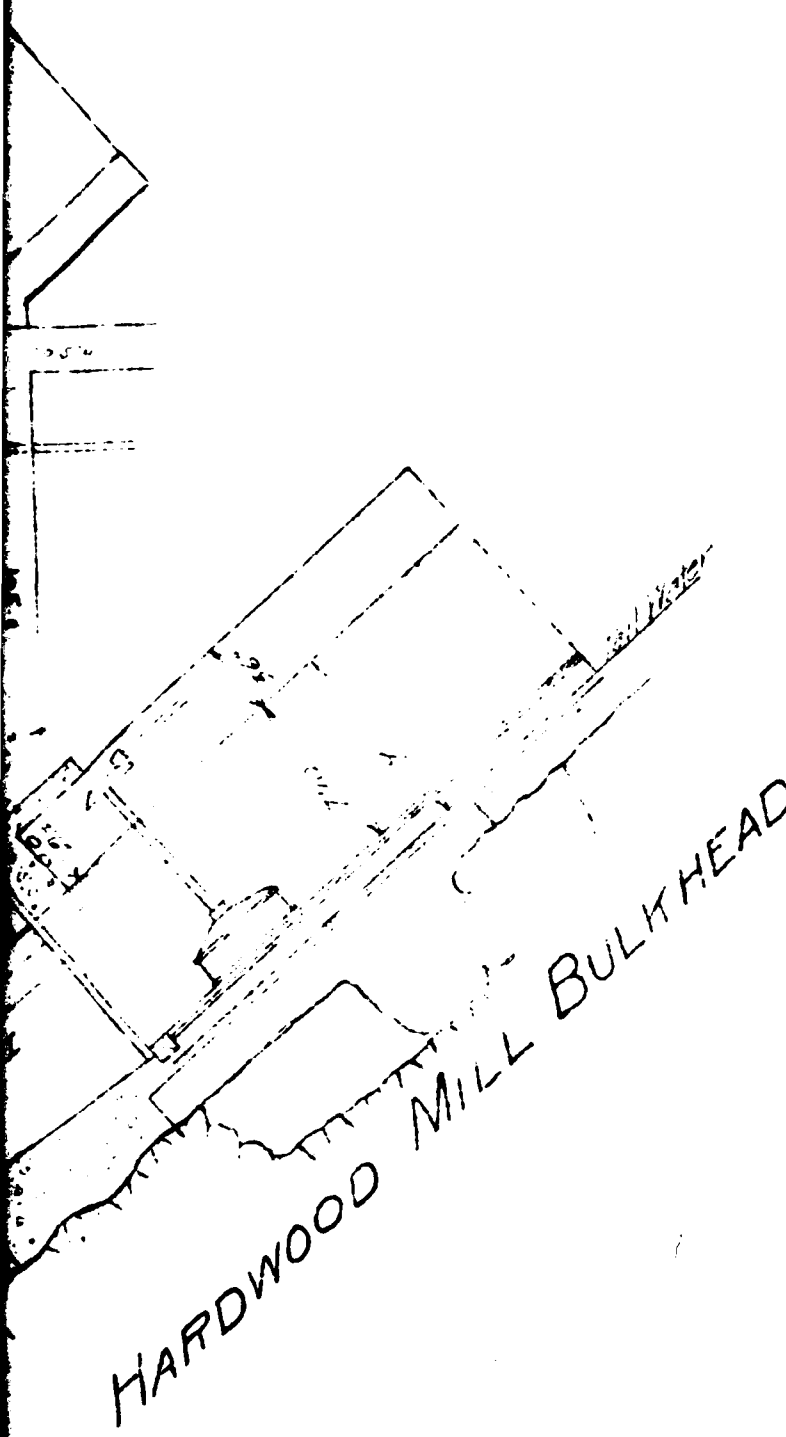
Note Change location of Log Sluice toward center - exposure to J. Lewis Co.



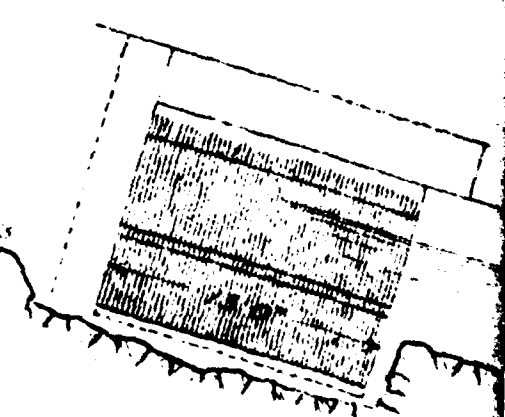
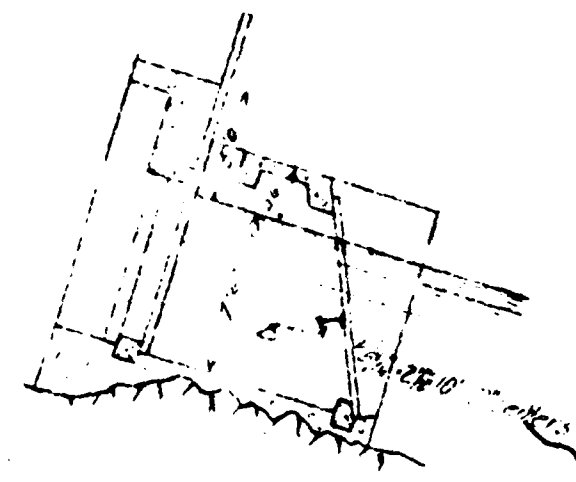
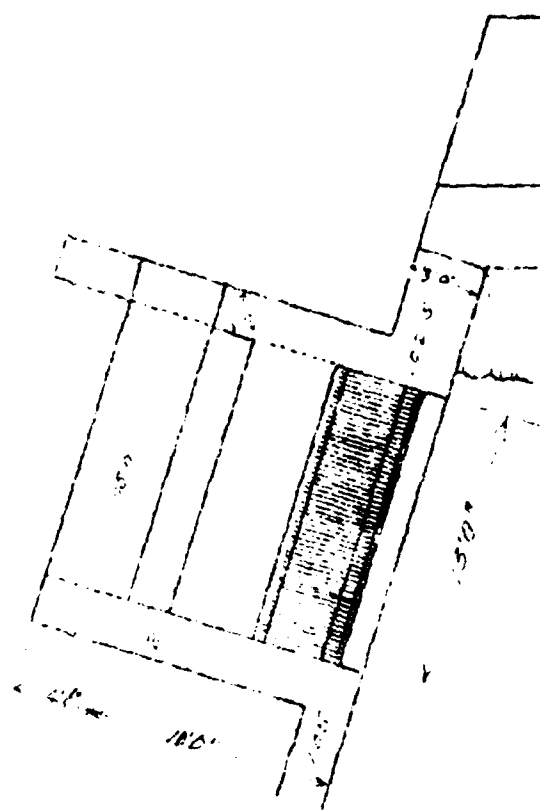
Bed rock very uneven. Taken as elevation 88.5 for estimate, this change.

## BULKHEAD & LOG SLUICE



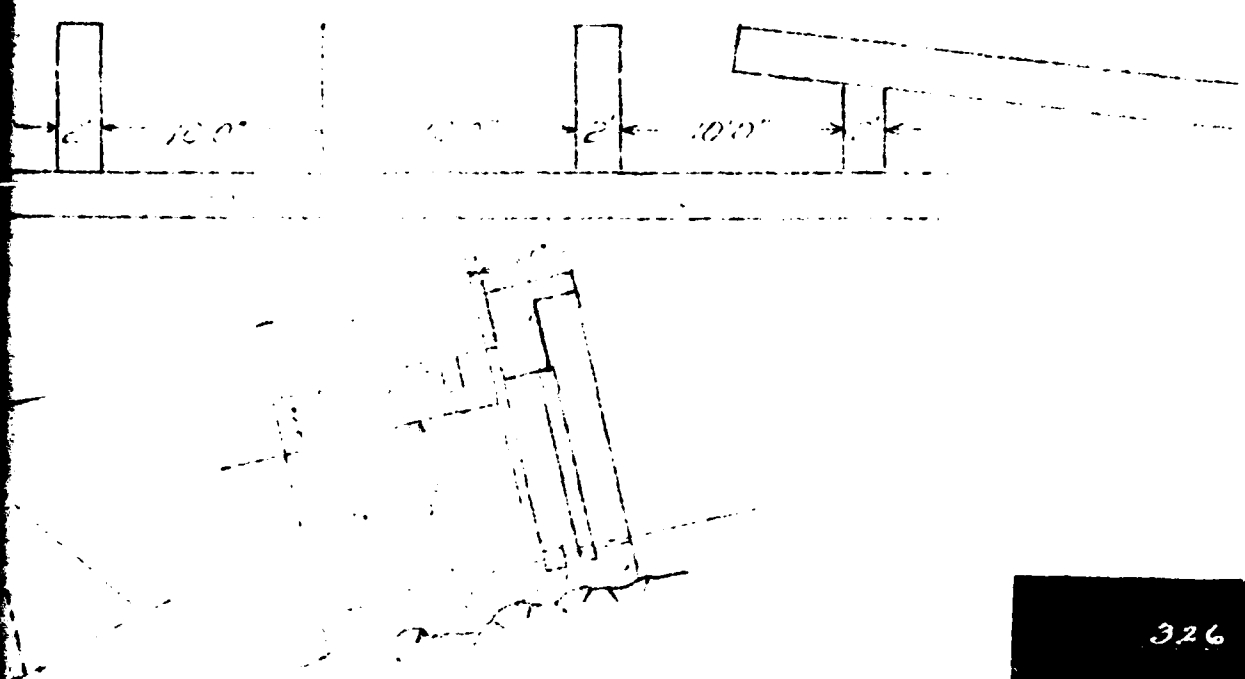


MILL BULK HEAD



6





326

340 Blast fire

That is to say, the...  
 of the...  
 of the...  
 of the...

7/1

MAXIMUM SECTION  
WING DAM

MAXIMUM SECTION  
SPILLWAY

PLANS OF BULKHEADS & LOG  
PROPOSED NEW CONCRETE

CROGHAN, N.Y.

TOWN OF CROGHAN, COUNTY OF LEWIS, STATE OF N.Y.  
ACROSS THE BEAVER RIVER

Submitted by *James H. H. H. H.*  
and son's one foot  
Date: May 10, 1918

Drawing No.  
**7217**  
File No.

James H. H. H. H.  
CROGHAN

*James H. H. H. H.*

SECTION  
24

MAXIMUM SECTION  
SPILLWAY

PLANS OF BULKHEADS & LOG SLUICE  
PROPOSED NEW CONCRETE DAM  
CROGHAN, N.Y.  
TOWN OF CROGHAN, COUNTY OF LEWIS STATE OF NEW YORK  
ACROSS THE BEAVER RIVER

Scale 18" = 1' high  
equals one foot  
Date: May 10, 1918

Drawing No.  
7217  
File 7217

James F. McNamee  
Engineer  
Catharine, N.Y.

